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ABOUT THE AUTHOR: PETER LOEWER is the author-illustrator of *The Indoor Water Gardener's How-To Handbook*, already a classic for houseplant growers, and the illustrator of *Growing Unusual Fruit*. A graphic artist and illustrator of biology and natural history books as well as those dealing with gardening, he lives in a large house in Cohecton Center, New York, where he invents and field tests all the ideas that he offers in this book.

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VINES, WILDFLOWERS, FERNS, MOSSES,
BULBS, CACTI, AND DOZENS OF OTHER
PLANTS MOST PEOPLE OVERLOOK

written and illustrated by

H. Peter Loewer

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Bringing the Outdoors In

Preface

When my wife and I decided to leave the hectic glamour of city life and return to rural green, my house-plant collection was bequeathed to friends and acquaintances. We had rented a van for furniture and books that in no way resembled the effortless moving commercials seen on TV, our car was stacked to the roof with my wife, her mother, the best china, two Siamese cats struggling to escape from pet carriers, enough food for a week, boxes of art supplies, and an unabridged dictionary, all of which left no earthly room for plants. Besides, I rationalized, our future home was surrounded by fields, wild flowers, and trees, providing ample evidence of nature.

We moved in July, had the rudiments of plumbing by August, a chaotic kitchen by September, and our first nature walk in October. We worked on the house all winter, occasionally peeking through frost-covered windows at acres of awesome white, and by the following March were *literally* bonkers. After ten years of the relative camouflage provided by city brick and steel, we had forgotten the majesty of a northern winter.

The following spring, I had the choice of installing new gutters or building a small window greenhouse. Naturally, I chose the latter. The roof could make do another year, but obviously we couldn't.

The next hurdle was filling the window with greenery. I didn't know then about buying plants by mail, and the nearest commercial suppliers were miles away. In a short time, neighbors brought cuttings and plants from their collections, including many that had been in the family for generations. In the fall, I brought in some annuals from our pathetic attempt at a formal country garden, and

looked about the woods and fields for other likely subjects. By November, the window greenhouse was filled and helped us to get through the worst winter we have experienced to date.

That was four years ago. We still haven't finished the house (some say we never will, as remodeling is a lifetime occupation). But the spring beauty bloomed this morning—a bleak and gray day in early March: tiny pink blossoms that grace the spring woods were curled over the edge of a clay pot in the window greenhouse. Spring cyclamen, tulips, hyacinths, daffodils, azaleas and freesias have brightened the sun porch since late December. By the end of the afternoon, the foamflower buds will push their way through the soil and the lily will bloom for Easter. Two white catl eaya orchids command the center of the dining-room table, surrounded by a spray of “dancing doll” orchids, spots of bright yellow and brown that move in the breeze of passing-by. The Christmas poinsettia still holds its scarlet bracts, though its tiny flowers have fallen off. Next week, the columnea will be a six-foot mass of red, and then the cactus will dot the windowsills with white, pink, and yellow.

In a world that daily flirts with disaster, continually teetering on the brink of hysteria where the unbelievable has become the commonplace, and crises upon crises are flung at you from newspaper and TV, it's very easy to lose your orientation and find yourself asking where the time has gone. But when you think of the last time you saw a violet in spring, an apple tree weighted with blossoms, or the annual display of an African amaryllis, once again you can sense the true passage of time.

This book is the result of working with plants over four long winters in an effort to recapture the meaning of time.

Introduction

Each chapter in this book deals with a specific subject relating to growing plants or groups of plants.

Chapter 1 looks at plant growth, reproduction, and structure of plants. It is my firm belief an informed thumb is a green thumb. We all know that plants need light to exist, but when you realize the complexities involved, and when you remember that you have the responsibility for a living thing, it's somehow easier to make the effort in moving a plant that needs more light rather than putting it off with the idea that you'll get around to it later.

Chapter 2 shows how to construct small indoor greenhouses using existing windows without a large outlay of money or time. The average home carpenter should be at ease with the specifications, and I've tried to list all the materials needed.

Chapter 3 lists standard potting mixes and also defines a number of commercially available soil components to help the grower in devising his own. The pH reading is at best a debatable point with many people (some never pay it a second thought) and many plants will struggle along in just about any kind of medium that will hold their roots, but these will never reward you with their best efforts. In the wrong soil, the majority of wild flowers and bog plants won't even struggle, they'll just fade away. Soil-less plant mixes are a fairly new arrival on the horticultural scene. I have never been overly involved with them because we have an active compost heap in the back yard and a ready source of leaf mold from the woods, but many people live in suburbs and cities, where soil is not easy to obtain, especially in large amounts, so I've included recipes for these mixes.

Chapter 4 deals with pots and the variety that is available today, along with information on the new self-watering pots.

Chapter 5 concerns the different methods of plant propagation. It's not meant to be a definitive treatise, but shows the many techniques used.

Chapter 6 describes how to set up a terrarium, and how to stock it with some interesting plants found in nature. Once again, it does not list every native plant that would work in a bottle garden, but common representative types of each. It is assumed that any plant hobbyist who is more than casually interested will check the bibliography in pursuit of more information.

Chapters 7 thru 11 deal with varieties of plants that grow in unique and individual manners and suggests equipment that will help these plants on their way.

Chapter 12 concerns insectivorous plants, how to care for them, and where to look for natural specimens. If a field trip into swamp is not exactly your idea of a great afternoon, then consult Chapter 16 for commercial sources of supply.

Chapter 13 gives an easy method for forcing outdoor bulbs for winter bloom. Once again, it does not list every bulb that is capable of flowering with this treatment, only those that I've grown.

Chapter 14 is a compendium of garden plants that may be brought indoors, gift plants exchanged on holidays and kept all year instead of being tossed out when the blooms have faded, flowering plants that may be easily grown from seed to bloom indoors, and a couple of time-honored house plants that tend to be overlooked because they are thought to be old-hat.

Chapter 15 lists the more common ailments that will afflict plants in the home. While not a strict organic cultist, I do have a healthy suspicion of many of the chemicals that are freely sold today, know that they do the job, but having read labels, prefer to leave them to the expert, and rely on more mundane methods.

Chapter 16 lists sources of supply, magazines, and plant societies.

The Appendix gives some informational tables, and the bibliography lists a great many books, available for sale or in libraries, for the person who would like to delve a bit deeper into any aspect of this book.

I have tried to avoid endless listings of plants that can be grown indoors. Not only would that be a bore to read,

but such lists have been published by the score. Instead, I've chosen a smaller number of plants, grown them in average home conditions and prepared the drawings from live plants, in the belief that photographs in books rarely succeed in describing the living feel of a plant, unless priced out of the reach of the average buyer and presented in a coffee-table format.

Undoubtedly, I have also made mistakes. One of my favorite plants could possibly be twice as large and three times as beautiful if I had known a different approach, but I'll never know until someone else points it out, and as yet, I've never been disappointed in any of them.

In addition to family, I wish to extend heartfelt thanks to the following people for their help in preparation of this book: Mrs. C. F. Rogers of Hialeah for introducing me to the plant life of Florida; Mr. Douglas Heinle of Cocheton Center, New York, for donning his Post Office hat with efficiency and dignity thereby proving that the United States Postal Service can work; Mr. Richard K. Winslow, my editor, for his encouragement of and patience with this project; Ms. Barbara Huntley, art director of Walker, for her welcome assistance and unerring sense of design; and lastly Mr. T. Williard DeSantis of Narrowsburg, New York, for his inventive mind, creative approach to carpentry, and invaluable aid in developing the plans for construction.

CHAPTER ONE

The Plant World

A plant is a living thing. It's subject to the same rules and regulations that govern the human body. Without light, plants become anemic, without air, water, and food, they slowly waste away. Too much heat or too much cold will generally do them in. Without an occasional rest, they push themselves to an early demise, and without routine maintenance, they quickly appear unshaven and unshorn. Like people, plants respond to extra attention, although I'm not fully convinced that a carrot screams when yanked from the earth or a philodendron reacts to my innermost fears.

In order to get the best results from your house plants, it is important to understand something of the mechanisms that are basic to their growth and development. It's much easier to pinch back a favorite plant if you know why such a process works, and that the pinching will not harm it in any way.

I freely admit that no one seeing a newly bloomed cattleya orchid, cries out: "Did you ever see such a beautiful inflorescence?" Or upon spying an emergent white fly calls: "There's an Aleyrodidae on the pinnately compound leaf of my *Calamus ciliaris*!" Perhaps a turn-of-the-century, die-hard botanist in an Elinor Glyn novel would utter such a mouthful, but not the typical horticulturist of today.

However, when you have trouble with your plants, or when you are particularly proud of a specimen that you've slaved over and you want it to keep its spectacular health, it really helps to have a basic working knowledge of plants and their nomenclature under your belt. Once you become seriously interested in growing plants, you will

find that basic reference works like Graf's *Exotic Plant Manual* and the many horticultural magazines require a good basic botanical vocabulary

TYPICAL PLANT CELL

All living things, whether plant or animal, are made up of individual units called cells. Usually, these cells are too small to be seen without a lens or a microscope. Some bacteria, the smallest examples of plant life, consist of a single cell, 1/50,000 of an inch in diameter. The giant sequoias of California are over 350 feet tall and consist of countless trillions of cells. Not that you're about to grow a mature sequoia in your living room, but when you care for a smaller plant you are not only the guardian of leaves, stems, and roots, but you take responsibility for all the cells that make up the plant—each one needing water, air, and food.

To form a three-dimensional picture of a typical plant cell, let's imagine a plastic Baggie about the size required for an average tuna-fish sandwich. Now we add the following ingredients:

- 1 thirty green peas to represent *chloroplasts*, the food-manufacturing units of plant cells. Chloroplasts contain *chlorophyll* (of chewing gum fame) and give plants their green color; they are responsible for the process of photosynthesis.
- 2 a handful of sand, each grain representing a *ribosome*. These organelles (literally, a small organ) aid in the production of protein, enabling many plants to become meat substitutes in most of the world.
- 3 three tablespoons of dried lentils which will become *mitochondria*, organelles that assist the plant cell in the chemical activities relating to respiration.
- 4 a few tablespoons of tapioca, representing *leucoplasts*, the organelles of starch formation. Any excess carbohydrates produced by a plant
- 5 one marshmallow stuffed with a few kidney beans and three or four yards of sewing thread. The marshmallow is a stand-in for the *nucleus* or "brain" and controls all the activities of the other organelles and structures, since it determines when the cell is to grow, to divide, and to

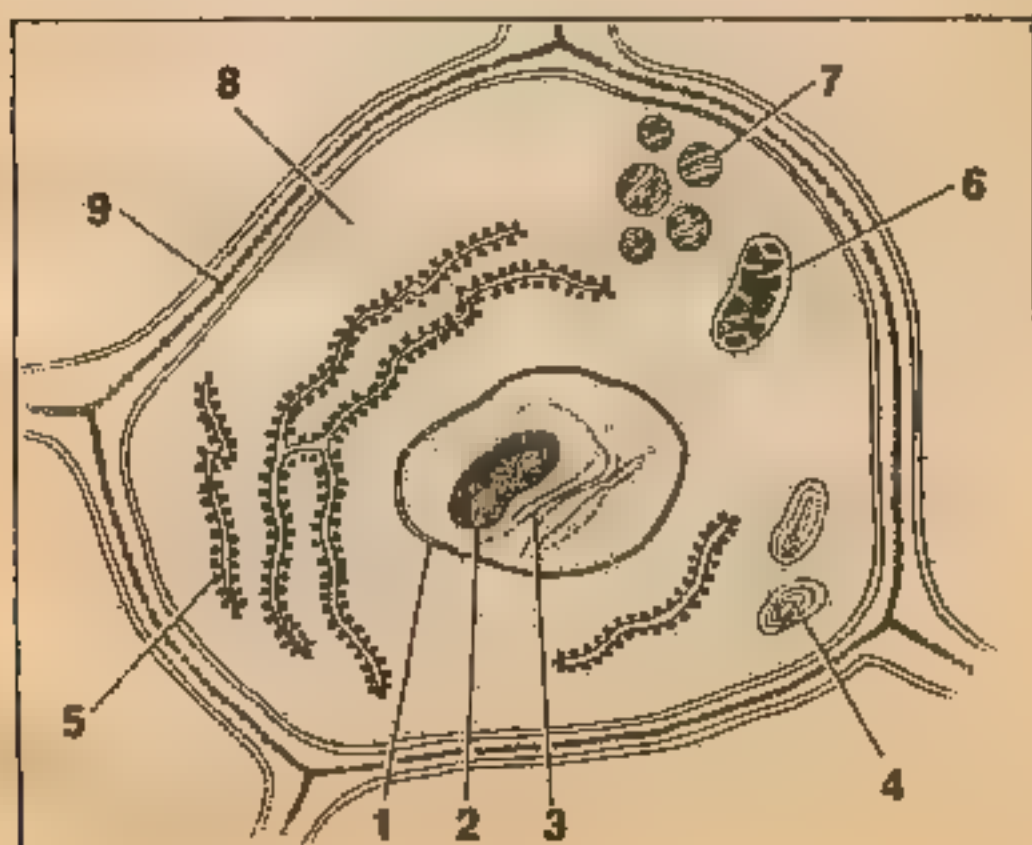
die. The kidney beans become *nucleoli*, rich in protein and helpmates in the process of cell division. The thread acts as the *chromosomes*, genetic components of every living cell and dictators of the cell's heredity

Now fill the remainder of the bag with plain water and seal the top. The water represents *cytoplasm*, the basic liquid of a cell that holds all the organelles and structures in suspension. When the cell nucleus is included in any discussion of a cell, the cytoplasm is termed *protoplasm*.

We now have a very soft and malleable model of a plant cell, about ten thousand times larger than its real-life counterpart.

But plant cells are not soft, and here we have a major distinction between plants and animals, the structure of the cell wall. In animals, cell walls are like our Baggie until bones, skin, shells and other tough materials hold them in shape. Plants rely on a thicker cell wall that contains cellulose and can easily be pictured by putting our cell model into a slightly larger cardboard box, much like the containers used to freeze vegetables.

The following diagram shows a typical plant cell as seen under an electron microscope, (1) nucleus, (2) nucleoli (3) chromosomes, (4) leucoplasts, (5) ribosomes, (6) mitochondria, (7) chloroplasts, (8) cytoplasm, (9) cell wall.



In addition to cell walls, the more advanced plants (like the trees and flowering plants) have specialized cells to act as supports and conduct water throughout their systems. Plants like the mosses and molds lack these additional supports and can never grow any larger than they are at present.

THE LIFE PROCESSES OF A PLANT CELL

Most plants have the ability to transform simple substances into their food. The most important of these substances, taken from the soil and atmosphere, are carbon dioxide and water. In combination with chlorophyll (manufactured in the chloroplasts), when triggered by sunlight or artificial light, carbon dioxide and water combine to produce carbohydrates in the form of dextrose, the staple form of energy for a plant. At the same time, pure oxygen is produced as a by-product. This process is called *photosynthesis*. The chemical process is really simple. Water contains hydrogen and oxygen. Carbon dioxide consists of carbon and oxygen. In the presence of radiant energy, chlorophyll produces dextrose, which is a chemical combination of carbon, hydrogen, and oxygen with excess oxygen released into the surrounding air. Those plants we associate with dark, dank, and gloomy places, such as molds, mildews, and mushrooms, do not have chlorophyll and are unable to photosynthesize their own food. Instead, they live on the remains of other plants and animals. Or, thriving in our kitchens, they exist on stale pieces of bread.

Photosynthesis is, without doubt, the single most important chemical process in the world. Directly or indirectly, all of our food comes from plants. Just as vital, the oxygen that all living things require to convert food into energy is a direct result of photosynthesis. The green plant is the *only* significant source of free oxygen in our atmosphere. I cringe at the sight of rich farmland, ripped up and coated with layers of blacktop—for here is dead land.

In most plants (exceptions are the cacti and other succulents) the leaf is the center of the photosynthetic process. The exchanges of oxygen, carbon dioxide, and water vapor occur in small openings on the undersurface of the leaf. These openings, called *stomata*, are easily

visible under a hand lens as minute pores. At 300X they look like this:



During the day, water pressure builds up within the stomata walls, forcing them open. At night they lose water, collapse inward, becoming more or less closed. Water is lost through these pores as water vapor, to be replaced by water drawn up from the roots. This process is called transpiration and, even in the advanced botanical sciences of today, is not fully understood. It's assumed that since the stomata must be open during the day to take in air, the loss of water is a side effect, beyond the plant's control.

One of the major problems that plants have in today's well-heated homes (most plants welcomed the Energy Crisis with open leaves!) is in maintaining a balance between the water lost from the stomata and the overly dry conditions surrounding them. Remember, the humidity in an average heated home is about 15 percent. Even the vast sandy and parched Sahara Desert enjoys an annual average of 25 percent humidity, so you can see why house plants, especially tropicals, appreciate a frequent application of water with a misting can or atomizer.

Of the four major methods of home heating (hot-air, hot-water, steam, and electric) the last is one of the best for plants because the heat is relatively constant—there is no fan or forced air equipment needed to move the heat around. Hot-water heating is the next best; the changes in temperature are always gradual. Hot-air heating has a definite drying effect, especially if a plant is placed in front of a heating duct; the steady blast of hot air dries out the leaves quickly, and the roots need additional waterings as the soil becomes rapidly depleted of water. By liberal placement of gravel and pans filled with water, the humidity can be re-established. Or you might consider adding a humidifier to the furnace system. It's a relatively

inexpensive addition, and the additional humidity benefits plants, furniture, and people. Steam heat causes rapid fluctuations in temperature, and plants must be kept away from pipes. (When any of the plants described in later chapters have particular temperature needs, I'll cite them individually.)

Since the stomata close at night, you will occasionally find drops of water at the tips of the leaves in the morning, especially those of the tropicals. Don't worry about it. When the stomata are closed, roots continue to absorb water, and any excess is released in droplets through special pores in the leaf tips. This occurs so that the plant maintains an even water pressure within. It's called *guttation* and sounds a great deal worse than it is.

THREE KEYS TO HEALTHY PLANTS

For your plants to flourish, you must see that they photosynthesize efficiently. This means they must get the proper amount of light, air, and water.

Light

Light intensity is measured in foot candles (FC). One FC is the amount of light cast on a white surface by one candle, one foot away, in an otherwise dark room. You can measure FC's with a photo exposure meter, using the simple FC conversion tables found in the camera instruction manual. If you've lost the manual, as I have, you will find a table in the Appendix that will convert meter readings to FC.

Plants that need full sun, such as cacti and most flowering annuals, generally require about 6000 to 8000 FC. Plants such as ferns and most begonias prefer partial shade or an average of 2000 FC, and plants like the deep jungle dwellers, require full shade or between 100 and 500 FC. Many plants will survive in 20 FC of light but 100 FC seems to be the minimum for growth.

Windows immediately cut down on light intensity with the loss of light through outside refraction of the glass and the fact that some light is actually absorbed by the glass. Now add architectural details such as eaves and cornices and more light is lost. A west window in mid-morning may read 400 FC at the inside sill, but only 10 FC six feet into the room, while the outside reading is

over 10,000 FC. If windows are lightly curtained, screened, or dirty (a major problem of the city dweller) more light is lost. Now add a layer of dust to the leaf tops and the amount of light received by the leaves is dim indeed. Plants should be dusted right along with books, table tops, and everything else. Remember a comfortable light for reading is 50 FC, but it's hardly enough to keep a plant alive, much less healthy.

In all the plant descriptions, I've included the light requirements in terms of Full Sun, Partial Shade, and Shady. The Foot Candle routine is your necessary first step to find the areas in your home that produce the optimum light needed.

Plants Under Lights

A new world has opened up for the plant lover who is denied adequate natural light for good plant growth. This is the method of growing plants under artificial light, using a combination of fluorescent and tungsten lighting. The process is a whole volume in itself, and the bibliography lists two excellent books available on the subject. All the plants in this book may be grown under lights, even in a closet, if the light intensities are high enough.

Carbon Dioxide

Because carbon dioxide contains both carbon and oxygen in the only source readily available to a plant, it's of primary importance to the process of photosynthesis and healthy plant growth. I've always thought that the success of many 'green-thumbers' might be due to not only the constant attention they give to their plants but the breathing they do in the plant area, giving the plants an extra shot of carbon dioxide with every breath. The plants literally grow on every word. I don't advocate hyperventilating for your plants every morning but there just might be something to it.

Generally enough carbon dioxide is available in the surrounding air to provide for a plant's needs, but there are many experiments in horticulture today which are trying to increase plant growth by releasing measured amounts of this gas in greenhouse atmospheres. The results in increased growth rate can be startling. The more sophisticated garden and plant catalogs sell automatic equipment for this purpose.

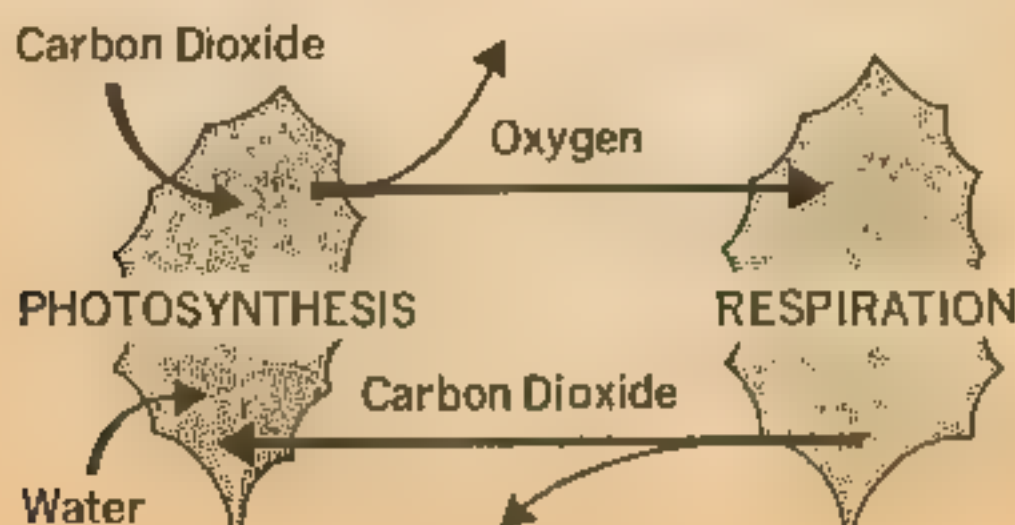
Water

Although water is needed by the plant to bring minerals from the earth and provide the basic ingredient for cytoplasm and the hydrogen for the photosynthetic process, the side effects of wilting can be disastrous. When a leaf wilts, the stomata close to prevent further water loss. Naturally this cuts down on the intake of carbon dioxide. As a result, the plant cannot use the carbon and oxygen to produce the dextrose needed for energy on the cellular level, and must rely on its reserves. If a plant has not wilted too badly, it will generally snap back, but successive wiltings damage it both with respect to cell damage and loss of potential food energy.

RESPIRATION AROUND THE CLOCK

Respiration is the process that supplies cells with the oxygen they need to convert the food produced by photosynthesis into energy. All plant and animal cells respire. Breathing is a purely mechanical activity developed by many animals in which large amounts of oxygen are allowed to reach the cells deep inside the body. Most animals need this additional oxygen to provide the energy required for movement. A plant does not breathe as animals do, but absorbs the needed oxygen through the roots, stems and stomata. In essence, all plants and animals respire, but only animals breathe.

Respiration occurs twenty-four hours a day in every living plant cell. Each cell absorbs the needed oxygen through the stomata, and also by diffusion through the roots and stems, releasing carbon dioxide as a waste product. Photosynthesis occurs during daylight hours, only in those



cells that have chloroplasts and generally in the plant leaves, taking in carbon dioxide and the hydrogen from water, producing food and releasing oxygen as a by-product. If the two processes proceeded at an equal rate, with respiration using the oxygen and food as quickly as photosynthesis produced it, there would be no left-overs for growth and repair. Fortunately, photosynthesis occurs at a faster rate and a surplus of food and oxygen is produced. Thus a plant in a sealed container, given an initially adequate supply of water and soil, and ample light, may exist for years without outside help. This is the reason that a sealed terrarium works.

Temperature plays an important part in plant respiration. As temperatures fall, the activities of respiration decrease. Generally a ten-degree drop is considered the best. That is, a ten-degree drop from the average daytime temperature that a particular plant enjoys. If your plant does best in 70° during the day, try to give it 60° at night, if it likes 60° during the day, give it 50° at night. Most plant growth occurs at night. That ten-degree drop gives the plant additional aid in the digestion of the sugars it has produced during the day.

Once we know about the effect of temperature, we can prolong the life of a favorite flower on a plant. Blossoms on azaleas, orchids, lilies, tulips, and the rest will last longer if given a cool night. Like leaves, flowers are made of individual cells that continue to respire and grow, even if cut, and dropping the temperature slows everything down. When we go on vacation, I always move the plants to a cooler part of the house to slow down their activity. This also cuts down on their water intake and hopefully they won't dry out in our absence.

Not too long ago, people were so worried about the respiration activities of plants and flowers, they removed them from bedrooms and hospital rooms at night. They believed the carbon dioxide levels would become so high that human life would be in danger of suffocation. Experiments have shown that a greenhouse in early morning produces an increase of only one half of one percent carbon dioxide, but a crowded room at a cocktail party can raise the concentration fully one percent!

DORMANCY

Everything in life must rest at one time or another, and plants are no exception. After they have finished flower-

ing and the leaves have manufactured adequate food for the next year, plants usually enter a period of dormancy. This "quiet time" in a plant's life is governed by the natural cycle of growth and a combination of shorter days and a drop in temperature. Dormancy is particularly noticeable with plants from the temperate regions of the world. Tropicals are not so obvious, as they hold their leaves throughout the year, but few plants will flower, fruit, and continue to bear new leaves on a year-round basis. If they are forced to overwork for long periods of time, plants will ultimately die, literally worn out from overwork.

Most of the plants brought in from out-of-doors will slow down their growth for the bleaker part of the winter. Many of our wild flowers and spring bulbs will not produce flowers at all, if not given a period of rest in combination with cooler temperatures.

Trees give ample evidence of dormancy by dropping their leaves in autumn. Small northern trees are occasionally used for bonsai subjects. Every autumn their leaves turn color and fall, even though they are indoors, but your passion flower, growing by the window, will keep its green and leafy look all winter long. It will not flower or produce new leaves and will continue to rest until the coming spring. When plants are dormant, watering should be held to a minimum, just enough to keep the plant from shriveling up. Fertilizing should be stopped entirely.

LANGUAGE OF PLANTS

Whether talking to your florist or reading horticultural books and journals, it's a big advantage to have a basic botanical vocabulary. If plant instructions say "Pinch the terminal bud," it's a good idea to know where it is.

The first thing to remember is that all plants known to man have been given their own Latin names. In the 1700's when the present system of classification began, Latin was the international language of scholars, so it was the obvious language to use. Since then it's become a relatively "dead" language, but that's all to the good since unspoken languages do not change. When you think of the many local names for plants that are different from place to place and country to country and generation to generation, it's obvious that some system of identification had to be established so that clear communication could exist

between a New Jersey horticulturist and a Japanese botanist, and more important between you and your mail-order nurseryman.

The three terms in general use are: genus, species, and variety. In print, the genus and species are always italicized and the genus has an initial capital letter. The variety has initial capitals, is in Roman type and set off by single quotes. Thus the grape hyacinth found in many modern gardens and window sills is also known as *Muscari armeniacum* 'Heaven y Blue'. The term *Muscari* spp. refers to all the species of the genus *Muscari*.

Not all plants have varietal names, but occasionally a "sport" or mutation will occur, by accident or design, that has a color, leaf shape, or other characteristic that is different from the parent plant. When this characteristic shows up in succeeding generations it is said to 'breed true.' The new form is not different enough to win its own species name so it is tagged a variety. Occasionally you will see three names in Latin as *Dracaena fragrans* var *massangeana* (the cornstalk plant of house-plant fame). The third name is still the variety but has been latinized, as the plant was named before the modern code was established, and in keeping with the code, the word 'variety' is abbreviated and set in Roman type. You will also run across the same name without the addition of the "var."

In plant breeding, when two species are crossed in a search for new varieties, the resultant plant is called a hybrid. Hybrids do not usually breed true but are propagated by asexual means such as rooted cuttings. Hybrids are signified by naming the parent plants with an x or multiplication sign between the names as *Euphorbia bupleurifolia* x *clava*. (This plant is a thornless crown of thorns.)

In addition, you'll run across the word "cultivar." This signifies a variety of plant which is known only in cultivation and may or may not be reproduced from seed.

Now why bother? Suppose you wrote to a nursery and ordered a Christmas cactus. The clerk who received your order has a migraine and misreads "cactus" for "candle." A week or more later, depending on the post office, you receive a strange-looking plant, the likes of which you've never imagined could exist, a Christmas candle. If you had ordered a *Schlumbergera bridgesii* you would not have gotten a *Tillandsia imperialis*. Most suppliers now insist on dealing in Latin nomenclature. The majority

of these firms print catalogs which describe their products, rather than illustrating them, another reason to familiarize yourself with the accurate terminology.

PLANT TERMINOLOGY

In one of my reference books (Britton and Brown, *Illustrated Flora of the United States and Canada*) there are approximately 600 definitions of words relating to the study of the forms of plants. It is hardly necessary to commit all this terminology to memory but a few definitions are important, just to help in verbal descriptions when tracking down an unknown plant. All of the following terms generally refer to the most advanced members of the plant kingdom, the flowering plants.

Plants that live only one growing season—roots, stems and all—are called *annuals*. Their one function, in a strict biological sense, is to mature so as to flower and cast out seeds. The whole process takes but one season. Many annuals, when given proper conditions, will flower within six weeks from planting the seed. Sweet peas, soybeans, snapdragons, and *Schizanthus pinnatus* (poor man's orchid) are all annuals. Never bemoan the loss of an annual but simply plant more.

Plants that live for two growing seasons are called *biennials*. They generally send up stems and leaves the first year and put out flowers the second. In essence they are annuals that require more time to flower. Beets, carrots and parsley are all biennials but they are harvested for food the first year and the flowers are rarely seen.

Perennials are plants that live season after season, either aboveground, such as philodendrons and azaleas or belowground such as all the bulbs, corms, and tubers. When growing a perennial from seed, do not be disappointed when flowers do not appear the first year. Generally they must grow for a season before flowering. Most house plants are perennials, and remain with us for many years. Occasionally they outlive us, one of my neighbors has a Christmas cactus that goes back to the early 1900's. It occupies a hanging washtub in a basement corner, and since the introduction of hot-air heating in their farmhouse, it is brought upstairs every year in March, a veritable mass of scarlet pink. Then it blooms for weeks, and finally is banished to the cellar for another year. At this time, it shows no sign of giving up.

Plants with soft stems, such as dandelions, lilies, and morning glories are called *herbs* or *herbaceous plants*. These are not to be confused with the herbs which are grown for flavoring and cooking purposes. Garden parsley, which grows quite well in a small pot for seasoning the year round, is an herb in culinary usage, an herb in botanical usage, and a biennial to boot.

Trees and shrubs that live many years and which grow larger in girth are called *woody plants*.

The difference between herbaceous and woody plants is more distinct in the temperate zone, as many perennials are grown for one season, then killed by cold weather. But when most herbaceous plants are brought indoors and grown year round their once-smooth stems become quite thick and calloused and develop woody tissue. I have an impatiens plant that has been growing now for four years and looks like a miniature tree at the base. The castor bean is another example of a northern annual that becomes a sizable perennial when grown indoors.

A typical flowering plant has the following need-to-know parts:

The terminal bud:



The flowers:

The leaves with the lateral buds between the leaf and stem:



The roots, primary root (vertical) and the lateral roots.



The whole plant aboveground is called the shoot.

When told to pinch back a plant to promote bushy growth, it is the terminal bud that is nipped off. If the plant has more than one stem, each terminal bud may be removed and thus more lateral buds are forced to develop, each of them turning into a stem with leaves and its own terminal bud. Plant hormones are involved in this very intricate and not completely understood process. Many botanists believe that until it is removed the terminal bud puts out a hormone that prevents the lateral buds from developing. It's a kind of safety factor that plants have evolved to give them more than one chance of survival in case of accidents or disease.

Since a complete plant is the total of many intricate parts, let's examine each of the parts and the role it plays to guarantee a healthy plant.

Roots

When a young seedling is beginning to grow it has only one root. As this root grows downward into the soil it produces branches to the side. If one primary root continues to grow alone, and remains the chief root system of the plant, it's called a *tap root*. If the lateral branches soon outstrip the primary root and eventually a mass of roots is formed, the plant has *fibrous roots*. Most of the plants grown for decorative purposes have fibrous roots, and it's a good thing. With so many, a few can be damaged through misadventure without any real harm to the plant.

In addition to the roots growing beneath the ground, there are *aerial roots* and *prop roots* that are found on many house plants. Aerial roots are chiefly found on the tropics such as philodendrons. Since many tropics grow in dense jungles, their ground roots are very slight, serving to nourish the plant as it starts its growth upward to the light. Along the way, aerial roots develop to in-

crease the moisture and food available to the plant in addition to acting as supports. When they grow on your philodendrons, leave them alone and congratulate yourself for having given your plant a happy environment. The fiery reed orchid (*Epidendrum ibaguense*) that I recommend later eventually covers its stems with aerial roots that shoot out in every direction. If you examine these roots closely, you'll see green tips: this is chlorophyll that assists the plant in manufacturing food.

Prop roots are found on many succulents and lend an additional measure of support to the stems. They add an interesting dimension to the stem and look like this:



Another word that you will read on occasion is *adventitious*—this refers to a root that occurs in an unusual place or at an unusual time of the plant's development. When leaf cuttings from plants such as coleus and geranium produce roots, these roots are adventitious.

When roots grow in soil or soil mixtures, they form many small root hairs near the tip. These hairs are responsible for the major portion of water that a root system absorbs. They are so tiny and completely enmeshed in



the soil particles, that when transplanted, many hairs are ripped from the parent root. Until the transplanted roots

grow new hairs, the plant loses most of its water supply and wilts. Luckily, root hairs grow quickly and the plant usually recovers. After transplanting, it's a good idea to spray additional water on the leaves and cover the plant for a few days with a piece of plastic wrap to serve as a miniature high-humidity greenhouse.

The shock of transplanting is also minimized by moving as much of the original soil that surrounds the root as possible. The older the plant, the safer transplanting becomes.

Many gardeners have grown cuttings or plants in water, and lost them when transplanting them to pots with dirt. If roots are grown in water, they generally do not form root hairs. They have adapted themselves to absorbing the needed oxygen directly from the water. When put into dirt with their small root systems and without the hairs, they tend to dry out before they can grow root hairs. There is a simple remedy. Add some soil or sand each day to the container of water. The root ends are stimulated by the particles, and soon hairs will grow. In about a week they should be ready for transplanting from their sludgy container to real soil.

As I mentioned earlier, all cells need oxygen for respiration. Roots are no exception. The oxygen they need moves from the air aboveground into the tiny spaces between soil particles. At this point, it is directly absorbed by the roots and root hairs. When watering plants, the descending water pulls oxygen in behind it. If the particles are packed too tightly, as in heavy clay soils, there is no room for oxygen and the roots quickly die. A few house plants, like mother-in-law tongue and the cast iron plant, can exist in clay, but they are rare exceptions to the rule. To help, coarse sand or gravel is added to the basic soil mixes. These hard particles will not meld together, and have air pockets for the oxygen.

What about plants that are purportedly to be watered from below—like African violets? I don't know of any plant, if watered correctly to suit its needs, that should be watered from below unless the soil becomes too dry and shrinks away from the edge of the pot. This happens occasionally to the most dedicated grower, you will know when it happens to you because the water appears in the saucer below as fast as you pour it in from above. Now is the moment for bottom watering. Set the pot in a pan full of water or in the sink and give it a good soak for a couple of hours. The water will rise through the soil

by capillary action and completely wet it. Now resume watering from the top as needed. Bottom watering can be quite a chore—imagine doing it to fifty plants! Besides, with the new self-watering pots, water wicks and the like, watering is not the job it used to be.

African violets, by the by, have leaves that spot easily when spattered with water, especially when it's cold. Many growers insist on bottom watering to prevent spotted leaves. Just use warm water and apply it carefully from the top, and you'll have no problems.

Overwatering can rob roots of oxygen too. The soil becomes so saturated, that once again air pockets cannot form and the roots haven't the time to adapt to the process of taking oxygen from water directly. They generally rot before the transformation can occur.

Stems

The stem has several jobs: to support the plant, to bear the leaves, branches, and flowers, to conduct water and minerals to the leaves, and to carry manufactured food to the roots. In the process of evolution, for the plant to survive in changing environments, stems have developed many interesting modifications: they have evolved into bulbs like the lily—to lead an underground existence; some have become the long trailing *lianas* (a term for a woody climber, generally from the jungle) that hang from trees and carried Tarzan over the gaping maws of the carnivorous plants of fiction; they've developed *holdfasts* for ivies and creepers to cling to walls of stone, and some have developed a twisting growth such as the one which carries the morning glory along a slender string. Branches are secondary stems and are called *runners* when they creep along the ground like strawberry runners, and *stolons* when they actively grow below the ground like the lily-of-the-valley or the wild morning glory. Most grassy weeds are well equipped with stolons and it becomes an almost impossible job to prevent their spreading.

Cacti have turned the stem into a self-contained fortress. Their stems provide structural support and also contain chloroplasts, which have replaced the leaves in the manufacture of food. The leaves have evolved into spines, for the defense of the plant.

The *pseudobulbs* of many orchids are modified stems, enabling them to store water for long periods of time.

I've always wondered why many garden books lump



corms, tubers, and rhizomes in with bulbs. If they are the same as bulbs, why do they have a different name? Well, they are not the same, but each is a different type of stem with the ability to store food. When you force a bulb, you are really forcing a stem

Rhizomes are perennial stems that are short and thick and give rise to aboveground branches. Iris violets, and orchids grow from rhizomes



Tubers are modified stolons or underground stems swollen with stored food. The sweet potato, potato, and tuberous begonia are tubers.



Corms are a series of underground stems that are squeezed into a short, broad, and fleshy package. Cyclamen and gladiolus are corms. If a corm bears small lateral buds on its surface, it only lasts one growing season, and a new corm is formed on top of the old, as in gladiolus. If the corm bears no lateral buds, like cyclamen

men, it will live from year to year, sending out new shoots to replace the old. It was knowing this simple fact, remembered from my botany classes, that led me to keep cyclamen corms growing all year instead of the old way of drying them every summer. Below is a gladiolus corm showing the tiny, lateral bud.



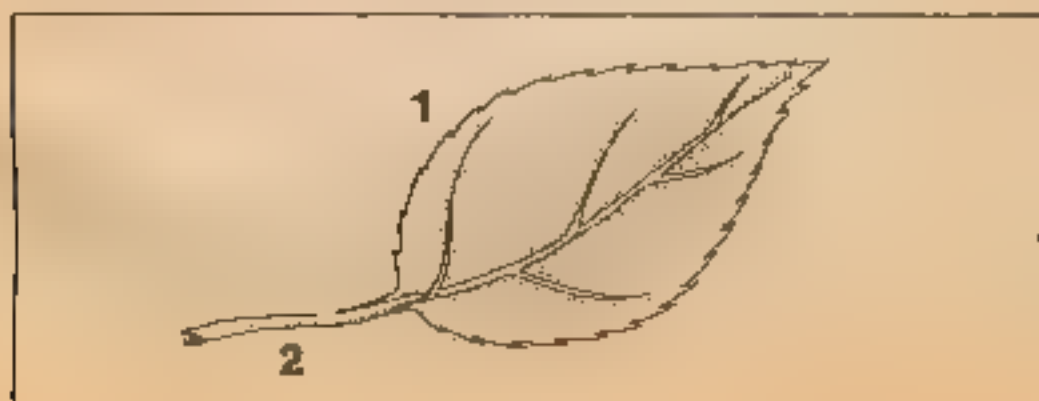
Bulbs are short stems wrapped in a series of leaves. If cut open lengthwise, you can see the embryo flower, already formed. Hyacinth and onion bulbs (1) are tightly encircled with leaves. Lily bulbs (2) have fewer and more fleshy leaves.



When a friend gives you a bag of unmarked bulbs, it's quite handy to know the differences. You might not get the genus and species but you can at least approximate the growing conditions.

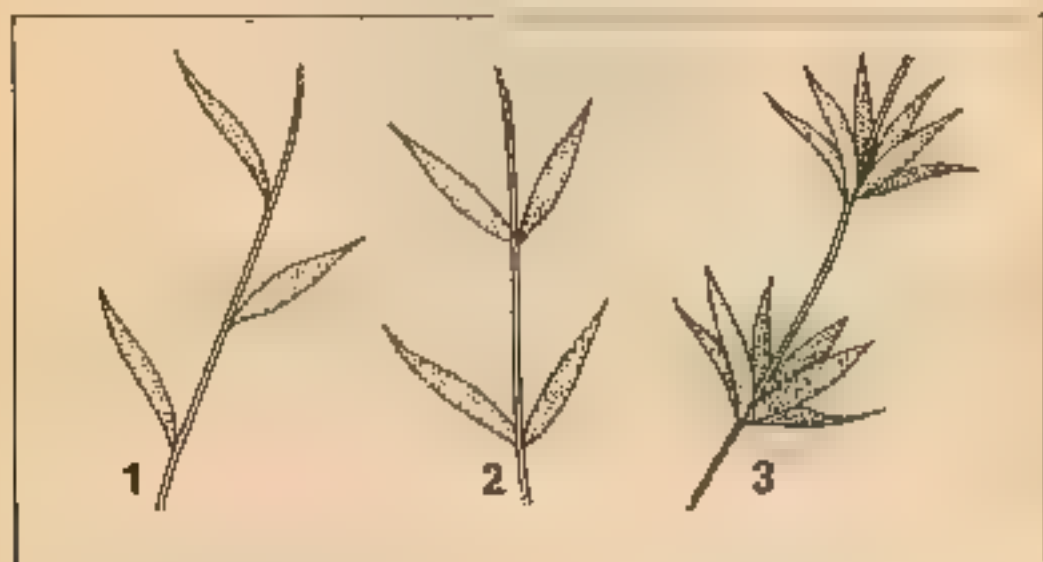
Leaves

The typical leaf of a flowering plant consists of (1) the *blade* and (2) the stem, or *petiole*.

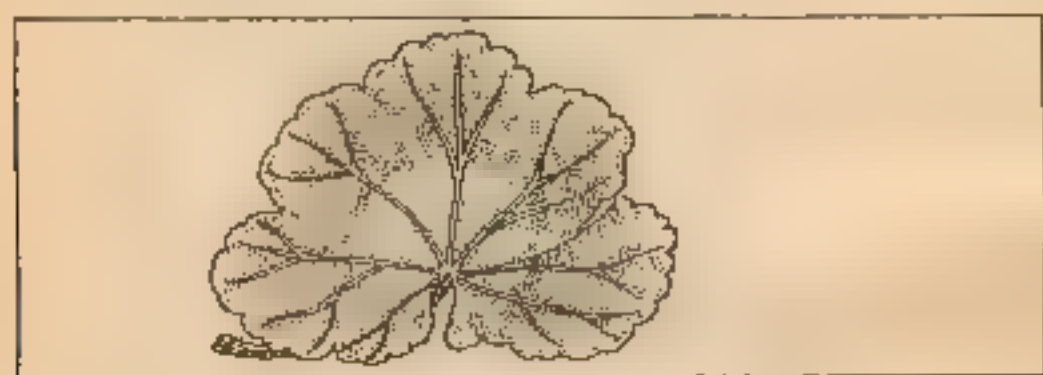


The undersurface of the leaf is covered by a network of veins* which distribute food that is manufactured in the leaf to the rest of the plant, and carry water to the leaf cells. One of the primary methods of propagating the Rex begonias (see Chapter 5) consists of cutting the main veins of the leaves causing tiny plantlets to form. This is a relatively uncommon occurrence due to the presence of cellular tissue that is capable of further growth and development.

Leaves are arranged on the stem in three basic ways—(1) alternate, (2) opposite, and (3) whorled.



Next we have *simple* and *compound* leaves. Simple leaves consist of one blade, that is not divided, such as a geranium leaf:



Compound leaves come in two varieties. *Palmately compound*, where the leaflets are all attached to the stem at one place, as in the Virginia creeper (*Parthenocissus*

* These veins are used to distinguish the two great subdivisions of flowering plants: the *monocotyledons* and the *dicotyledons*. Dicotyledons generally have leaves with a complex shape, such as a maple leaf; the veining forms a definite criss-crossed network. Young seedlings have two leaves.

Monocotyledons have simpler leaf shapes and the veins run in a parallel manner. The young seedling has one leaf. From the standpoint of plant evolution, monocots are considered to be the more advanced form. Orchids, grasses, and lilies are examples of monocotyledons.



quinquefolia), and *pinnately compound*, where the leaflets are arranged along a central stem as in the coffee plant (*Coffea arabica*):



Now we come to leaf modifications. There are four major groupings, and each signals an important environmental need. *Succulent* leaves have developed a thick, fleshy form for storing water under desert conditions or to protect the leaves from long periods of drought. They require only minimum care, but must not be overwatered or placed in soils that offer inadequate drainage. Under wet conditions, their roots quickly rot. These roots are very fibrous, enabling them to absorb the smallest amount of moisture in the soil. If waterlogged, these thin roots quickly perish from lack of oxygen.

Spines are modified leaves found on most cacti. These plants evolved under desert conditions, as succulents, but found a different solution to the water problem. By adapting their stems to food manufacturing cacti have given up the wasteful job of growing new leaves each year. The leaves they possess have turned to fairly permanent spines and protect the precious stem from desert marauders. Cacti require the same soil conditions as succulents and lose their roots to disease in wet and soggy soils.

Tendrils of climbing plants are the third modification. They allow their weak-stemmed owners to climb just about anything available as they search for light. In clematis, the stem or petiole wraps itself about a support

(see Chapter 7). In others, like smilax, the petiole divides on either side and forms a grasping tendril.

The fourth leaf modification is, without doubt, the most fantastic. These are the insectivorous plants. Because they grow in wet and boggy conditions, where soils are depleted in nitrogen and many other nutrients, the leaves have developed the ability to catch live food in the form of insects which act as a dietary supplement. The larger pitcher plants of the tropics can even digest small mice and birds. Strangely enough, since their leaves are abundantly supplied with chlorophyll, insectivores can manufacture sufficient food to exist, and even flower, without the addition of animal food, but growth and flowering is stimulated where insects are available (see Chapter 12).

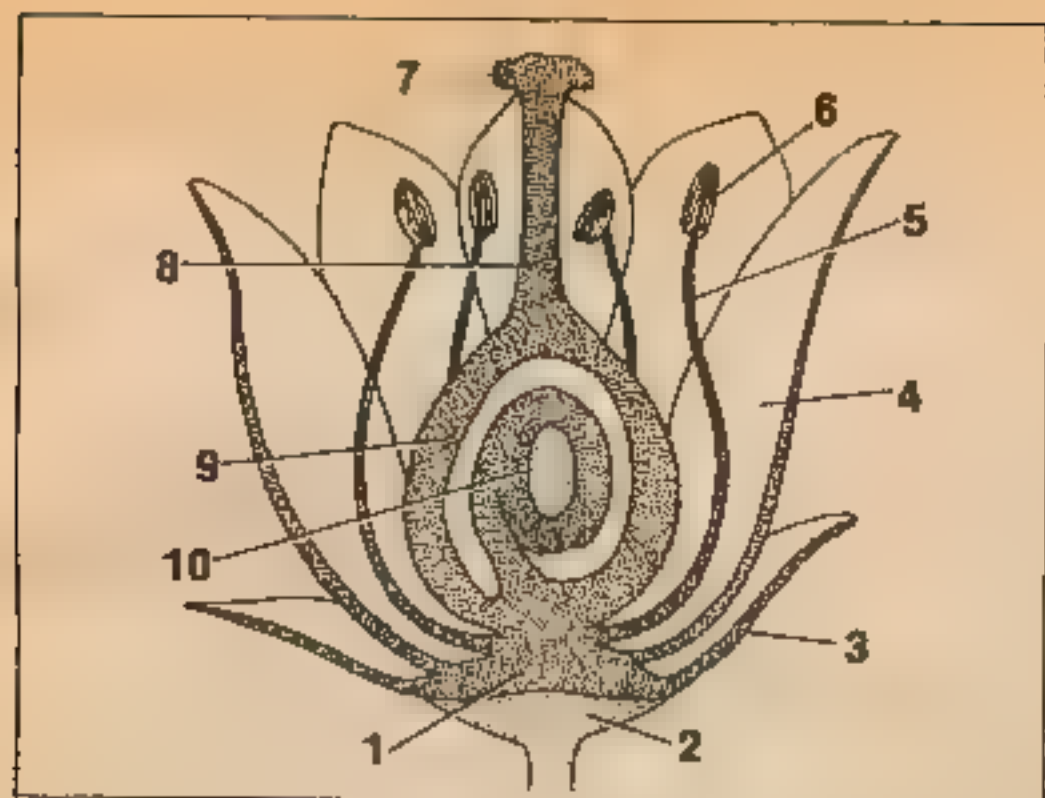
Another leaf modification that generally goes unnoticed is the *bract*. Bracts are leaves that pretend to be flower petals when the plants' flowers are small and insignificant. The colorful display of poinsettias at Christmas is due not to flowers but to leaves that have turned into crimson flashes of color. In reality, dogwood flowers are tiny and the white "flowers" we enjoy are bracts (see Chapter 14).

Flowers

The present endpoint in plant evolution is evidenced by the flower, the only structure that is capable of producing seeds. Most people tend to ignore this biological aspect and think of floral beauty as purely an esthetic statement by nature. Since their beauty is entirely the result of an effort to attract insects for pollination of the plant, it's extremely fortunate that we seem to have the esthetic sensibilities of the bee.*

All flowers are based on one general plan. Many have succeeded in hiding their similarities by structural changes, but the basic parts are there, if we look carefully enough. The following illustration shows the floral organs of a typical flower.

* Although we primarily think of the bee as the chief pollinator of flowers, other creatures are often involved. *Stapelia* spp. use flies (see Chapter 9), orchids are pollinated in nature by lizards, frogs, ants, beetles, flies, and bees, hummingbirds are the chief pollinators of columbine (see Chapter 11), butterflies pollinate many garden flowers, yucca cactus depends on a moth, and the hand of man is often used, completely replacing the pollinators of nature.



The *receptacle* (1) is attached to the plant stem by a special stalk known as the *pedicel* (2). The receptacle holds the *sepals* (3) which are collectively called the *calyx*. Occasionally sepals are brightly colored, as in tulips and lilies, but usually they are green. Sepals form a protective layer over the *petals* (4) which are usually brightly colored to form the initial attraction for insects, and are collectively called the *corolla*. Inside the corolla there are the *stamens* or male floral organs. The stamens consist of the *filament* (5) and the *anther* (6). The anther is the site of pollen formation. The female floral organ is called the *pistil* and is comprised of the *stigma* (7), which receives the pollen and is held by the *style* (8) which in turn is attached to the *ovary* (9) where the *ovules* (10) or seeds develop.

Pollinators, such as the bee, are attracted by the color and scent of the flower. Their goal is the nectar, produced by the flower. Usually nectar is made up of over 50 percent sugar and is the chief ingredient of honey. While searching flower after flower, the bee picks up bits of pollen that stick to the hairs on his body, mouth, and legs. Inadvertently, the bee deposits this pollen on flower stigmas, fertilization occurs, and ultimately seeds are produced.

Many flowers consist of both male and female floral organs and are called *complete* flowers. The lily is a prime example—many beautiful hybrids have been produced by cross-pollinating hybrids (see Chapter 13).

A few have separate male and female flowers on the same plant, as are found in the poinsettia (see Chapter 14).

The bittersweet vine of North America is an example of a plant that is either entirely male or female. Every year expectant gardeners wait in vain for the bright orange berries, because the nurseryman did not sell them two plants, one male (for the pollen) and one female (for the fruit).

When you have flowering house plants with complete flowers (both male and female) such as morning glories, you can do your own pollinating by dabbing the anther with a Q-Tip, or the like, and transferring the pollen to the stigma.

Some flowers refuse to be pollinated by their own pollen, and pollen from another plant of the same species must be used. The common day lily is a prime example, and many of the bromeliads will not self-pollinate.

At times the final result will be slightly disappointing as many of the large and beautiful flowers of today are hybrids, and each time you cross-pollinate, you travel back to the original flower and lose much of the impressive size and color. This is a fascinating hobby and many amateurs have come up with beautiful (and sometimes valuable) hybrids.

Multiple Flowers (Inflorescences)

Cyclamen, daffodils, and tulips are all examples of flowers that occur singly, and are called *solitary* flowers. In many types of plants, however, the typical flower is very small, and occurs in clusters called an *inflorescence*. This is an evolutionary adaptation to make the small flowers more easily visible to pollinators. There are many varieties of inflorescences, but the five most common types are.

- 1 A *head*, as found in the daisy and sunflower;
- 2 the *umbel*, typified by the onion family;
- 3 The *spike*, where the flowers are attached directly to the floral stem, such as gladiolus,
- 4 The *raceme* which resembles the spike, but where each flower is attached to the stem with pedicels, like the lily-of-the-valley and the hyacinth,
- 5 The *panicle*, characterized by the lilac and many of the bromeliads.



THE PLANT KINGDOM

When we look at a garden, formal park, or a greenhouse full of potted plants, we incorrectly assume that these are the main members of the plant world. The truth of the matter is much more complex, for petunias, pansies, orchids, and the like, belong to one group of a vast kingdom of plants comprising many divisions, almost all of which affect not only the health of our potted plants, but our very existence on earth. The knowledge that ferns are unlike flowering plants, that mildew prefers stagnant air, that green algae require bright light to thrive, allows us to understand conditions that not only affect the growth and development of our own plants, but affect disease as well.

The following are the major divisions of the plant kingdom. You'll undoubtedly run into examples of them all, whether by choice or misfortune.

Bacteria

These are the lowest on the ladder of plant evolution. They have but one cell, no roots, stems, or leaves, and no differentiation of sex. Bacteria cause untold death and

destruction in the world: more people have died from infectious diseases than all wars and car accidents combined; but without them, not only would the toothpaste industry fall apart, the whole world would fall apart. For these are the plants that reduce the dead bodies of other plants and animals into the simple chemical compounds essential to all life on this earth. When we sterilize soils to prevent disease to potted plants, we stay short of complete sterilization in order to protect many of the helpful bacteria that inhabit soil (see Chapter 3). Among the most important are the nitrogen-fixing bacteria which convert the nitrogen found in organic remains (a nitrogen that cannot be absorbed by plants) into a different chemical form of nitrogen which is readily used by plants for nutrition.

Algae

Algae are very simple plant forms, though many have more than one cell. The giant sea kelps of the Pacific Ocean reach lengths of over 100 feet but are algal forms no more complex than the green scum that grows on sides of sunlit aquariums and terrariums. Algae point out the way home by growing on the north sides of trees in the deep woods, and give promise of supplying the world's hungry with needed proteins. However, when growing on the surface of potting soils or covering glass walls, they should be removed. They are danger signals of too-wet soils, improper fertilizing, and too much light. We'll cover this problem again in later chapters.

Fungi

Mushrooms, penicillin, mildew, yeast, wheat rust, and athlete's foot are all members of the fungus family. As a group, they do not have chlorophyll and must live by living on others. Occasionally, mushrooms and fungus will suddenly appear in terrariums, spores having entered with the soil or other plant life. They should not be allowed to remain, regardless of their temporary beauty, as plants of this sort quickly decay: mushrooms quickly turning into a liquid mess and fungus also decaying, soon after covering the more attractive members of the planting. Fungus and molds are particularly fond of damp, closed containers, with little light or air (see Chapter 15).

Lichens

Lichens are among the slowest growers in nature. In reality, they are a combination of an alga which produces the food, and a fungus which provides the living quarters. Some rock-growing lichens produce colonies barely half an inch high, three feet in diameter, and well over three hundred years old (see Chapter 6).

Liverworts and Mosses

These are the delicate plants of moist, shady areas under trees and in gardens and are collectively called the bryophytes. Sphagnum moss, when dried, is widely used to germinate seeds because of its ability to hold water and the fact that it's absolutely sterile when found in nature. Many moss beds act as miniature seed flats and if brought into the home terrarium, will suddenly sprout an endless variety of woodland plants. Liverworts need the same growing conditions as most mosses, but are not differentiated into leaves and stems, consisting instead of flattened fronds similar in shape to a one-dimensional liver. There is an additional difference between mosses and liverworts involving certain structures used in reproduction that are important to a botanist (see Chapter 6).

Ferns

Ferns are well known by everyone. They've been used as house plants since Victorian times. They are relatively undemanding, but differ from flowering plants by bearing spores, not seeds, on the undersides of their leaves. It's the one time when clusters of small, dark things are not insects or disease, but future members of the fern family (see Chapter 6).

Club Mosses

These are the trailing and creeping plants of the forest floor, resembling miniature pine trees. They are familiar to most people as Christmas decorations and are used to make wreaths. Unfortunately, unscrupulous people have stripped them from the forests of the northeast and they are scarcer than they were a generation ago.





Horsetail

These plants are often seen growing along railroad beds and in ditches along roadsides. Their stems are hollow with tiny, scalelike leaves above each joint. Because the stems contain high amounts of silica, they were used in pioneer days to scour pots and pans. I always keep a pot of them for interest and a conversation piece (see Chapter 6).

Conifers

The evergreen trees. They do not have flowers but release their pollen from unripened cones, which in turn bear the seeds. In the spring, dusting around our house consists of cleaning up unbelievable amounts of yellow dust that blows in the windows from the neighboring pines. While generally not kept as house plants, the many young seedlings make most interesting pot plants for a few years, or subjects for bonsai.

Flowering Plants

The present endpoint in plant evolution, flowering plants, comprises the majority of pot-plant subjects.

The illustration shows a somewhat fanciful terrarium, because in a well-managed set-up, the grower should be quick to remove the algae and fungi, but the other plants are all likely container subjects. Each member of the plant kingdom pictured is a primary example of its division:

1 Soil bacteria

2 Algae growing on the glass

3 Two members of the fungus division (a) mold, (b) the tiny fairy mushroom

4 Lichens

5 Bryophytes (a) liverwort, (b) moss

6 Fern

7 Club moss

8 Horsetails

9 Conifers, represented by a white pine seedling.

10 Flowering plants, represented by a northeastern wildflower, the foamflower.

CHAPTER TWO

Constructing Window Greenhouses

In the past few years, the number of greenhouse manufacturers has steadily increased in the United States, and the once unglamorous, commercial greenhouse has undergone major redesigning. With the use of new materials of construction, greenhouses have become a valuable and esthetic addition to many American homes. For the homeowner with limited space or budget, trimly designed window greenhouses have appeared on the market; needing no foundations or major renovations, these units are easily attached to existing windows (see Chapter 16)

However, when attempting to construct a comparatively small area to house a plant collection, the individual who lives in a city apartment house or condominium faces major problems—in addition to budgetary considerations. Landlords resent any form of remodeling, including nail holes in plaster; city zoning and building codes usually prevent outside additions to buildings; fire departments resent blockage of fire-escapes; and the specter of home security is probably the greatest problem of all. Now add to these problems the fact that many apartment dwellers are continually faced with the possibility of moving and cannot justify any large expense for the installation of permanent equipment.

Keeping these limitations in mind, here are two plans for indoor greenhouses, using the most inexpensive materials available and requiring only rudimentary knowledge of carpentry. In addition, they are portable, requiring only a few screws to hold them in place. If you should move, they can be easily disassembled, and the screw holes in window framing filled with plastic wood; the next tenant and the landlord will never even notice.

As we have noted before, two major factors involved in growing plants are the control of humidity and temperature. Many plants mentioned later (especially in Chapters 6 and 12), do best with humidity approximating that of the outdoors. Temperatures in the modern home—even with a cut in fuel deliveries, are still too high for many plants. The enclosures described in the following pages should enable you to provide more controls.

TOOLS REQUIRED

You'll need a hammer, screwdriver, a steel tape measure, polymer glue, an electric drill with a 7/32-inch and an 11/16-inch drill bit, a sharp saw or saber saw, and a framing square for right angles. Your ability to get along with the neighborhood lumber yard will be the deciding factor in needing additional tools, but we'll cover that contingency while discussing construction.

A FULL INDOOR WINDOW GREENHOUSE

The illustration shows all the details of construction, and is planned to fit around the window frame of an existing window. Lumber consists of standard one-by-twos, 3/4-inch AA plywood (exterior grade, since humidity will require waterproof glue) and 3/32-inch Lexan glazing—a clear plastic often used to replace window glass subject to continual breakage. All these materials are available at lumber yards, and if you're sure of your measurements, they will cut the plastic for you. At the time of this writing, Lexan costs about seventy-five to eighty cents a square foot. If you ask the lumber yard to cut it for you, the cost will probably be up to one dollar a square foot. It comes in a standard three-by-six foot stock size. Thicker grades are available, but the cost goes up astronomically. If you do not have rapport with the men at the lumber yard or wish to save the cutting fee, you can cut this plastic sheeting yourself. Use a saber saw (with a fine-tooth blade) set at slow speed, or a hacksaw with a fine-tooth blade, or score the sheet with a utility knife, and break along the slice.

Screws are used instead of nails. I recommend using

flat-head sheet-metal screws, size 10, 1½-inches long, because the thread runs up to the screw head.

Obviously the plans should be modified to fit your window, just be careful with your measurements.

1 The basic frame is constructed of plywood. Fit a one-by-one spacer between the side and the window frame to avoid cutting around the window sill, and remember to remove a bit to fit around the baseboard. After the frame is finished, screw into the side of the window trim with 2 ½-inch size 10 screws, making a hole with a 7/32-inch bit.

2 The top piece of the frame is dropped at least an inch to provide clearance for the wooden brace that holds the plastic front in place. The front of the frame is finished with one by twos.

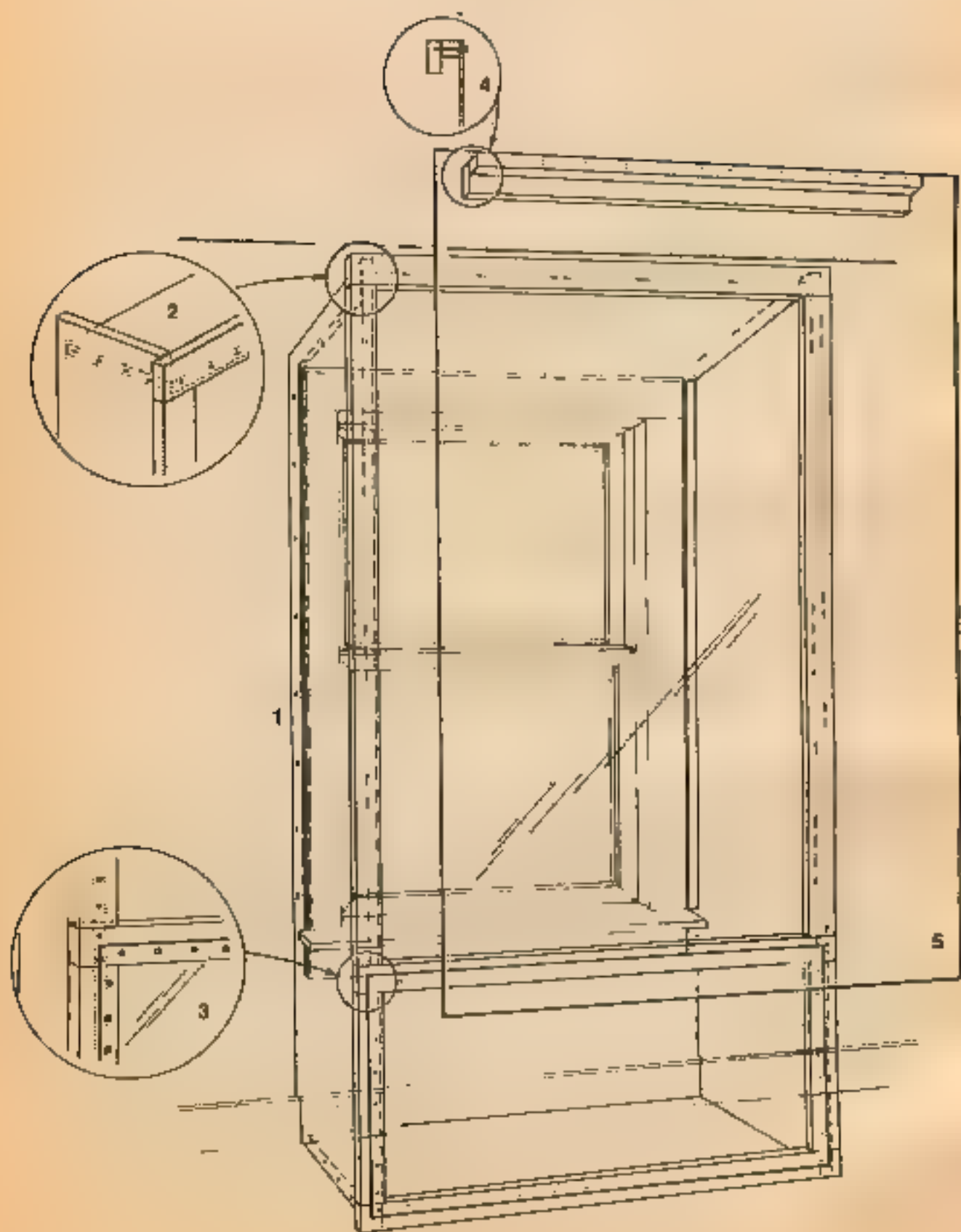
3 Since the Lexan comes no larger than six feet long, if you're making a large unit, this bottom piece of Lexan, screwed to the one by two's enables you to keep the front clear. Drill holes in the plastic, using the 7/32-inch bit, and ¾-inch size 10 screws.

4 The brace for the Lexan doubles as the wooden hook, holding the plastic in place. Use a one by one topped with a one by two. Use the 7/32-inch bit and drill holes, then screw with 1½-inch size 10 screws, adding a rubber washer before tightening each screw.

Lexan comes covered with plastic film to protect it during shipment. Remove only enough of this film to give you clearance for working. Wait until you are done to remove the rest, as this plastic scratches easily.

Paint the inside with a white, waterproof paint to give added reflection of light. Add aluminum cookie or baking pans to the bottom, and fill them with gravel and water for humidity.

Using your imagination, you can most likely arrive at many different applications of this basic design. You could add lighting if your window is not particularly bright, or by using light fixtures alone, you can construct the unit in a dark corner (see Chapter 1 and Bibliography).



A SMALL PLASTIC WINDOW GARDEN

The same basic materials are used for this unit as in the first.

1 The basic frame is made of one by twos, with a plywood bottom that will rest on the window sill, affixed with two screws when the unit is finished.

2 The side-frame angles are figured with your eye or a sliding T-head from the hardware store. They can be screwed, nailed, or held together with tops from frozen orange juice cans and two 4d nails. The Lexan is cut to size and screwed onto the frame. Two cross pieces of one by two are screwed on with 1 1/2-inch No. 8 sheet-metal screws. The frame is screwed to the plywood bottom. A front piece of Lexan is screwed onto the frame and the front edge of the plywood bottom.

3 In order to hold the plastic top, it is bent with the application of heat. This forms a good seal and adds rigidity to the plastic.

4 A small plastic strip is glued to the bottom of the cover to catch condensation which will drip into the unit instead of on the floor.

5 Legs consist of two two by threes. They can be nailed, screwed, or hinged.

6 This shows the set-up for bending the plastic. Two one by twos and two 6d nails hold the plastic sheet in place. For heat use a propane torch. Three hundred degrees F. is enough to soften this plastic, so never get the flame too close. If the wood starts to char, you are too close! Pass the torch back and forth where it leaves the wooden frame. When the plastic starts to drop down, press it with a dry rag or piece of wood, and when the desired angle is reached, rub the crease with a wet paper towel to cool it. If you don't hold the sheet down as it cools, it will revert to its original shape.

Any sharp edges can be filed and sanded to smoothness.

Most hobby shops now stock equipment for bending plastic. They're called heating strips, and are very easy to use.

SHELVING FOR PLANTS

Endless methods for making shelving are now on the general market, but the following two ideas give finished and attractive results with little investment, plus they allow free circulation of air.

The first shelf is made from $1/2$ - or $3/4$ -inch EMT metallic electrical tubing. It's smooth and galvanized both inside and out for protection against water. I prefer the $3/4$ -inch for added stability.

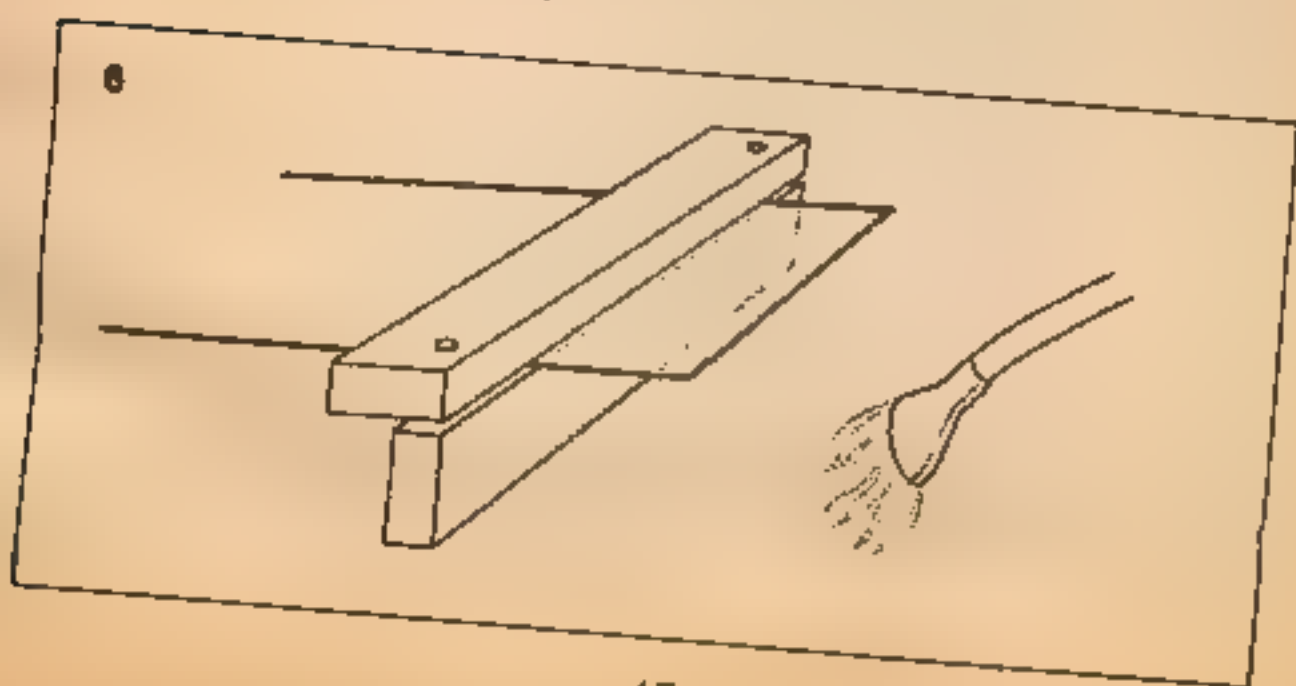
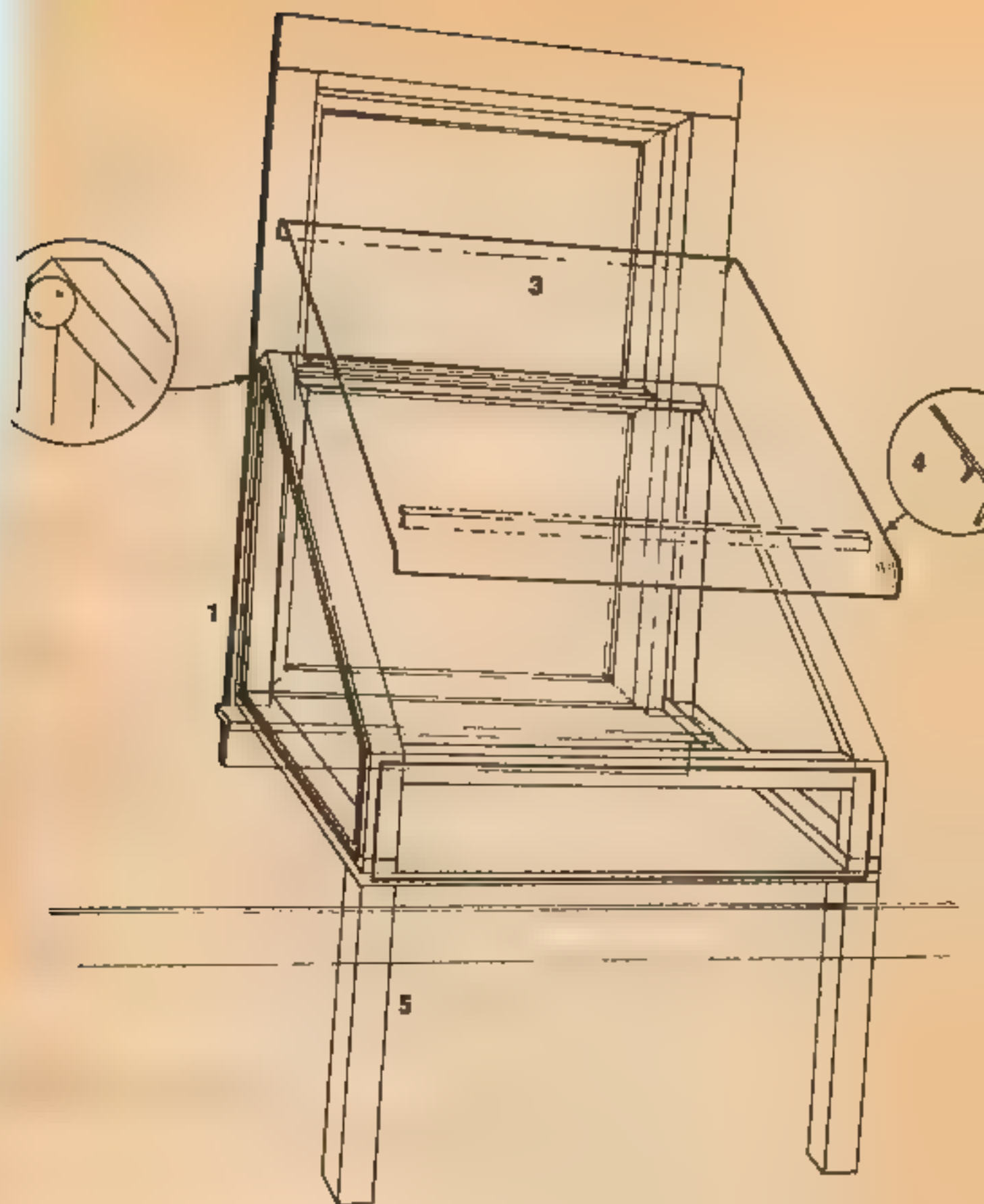
Take a one by three and drill holes with a $15/16$ -inch bit, keeping the holes in a straight line. Cut the piece exactly in half and then screw to either end of your unit. Now cut the tubing into the correct length, using a fine-toothed hacksaw or a cheap plumber's tubing cutter, which still retails for about two dollars.

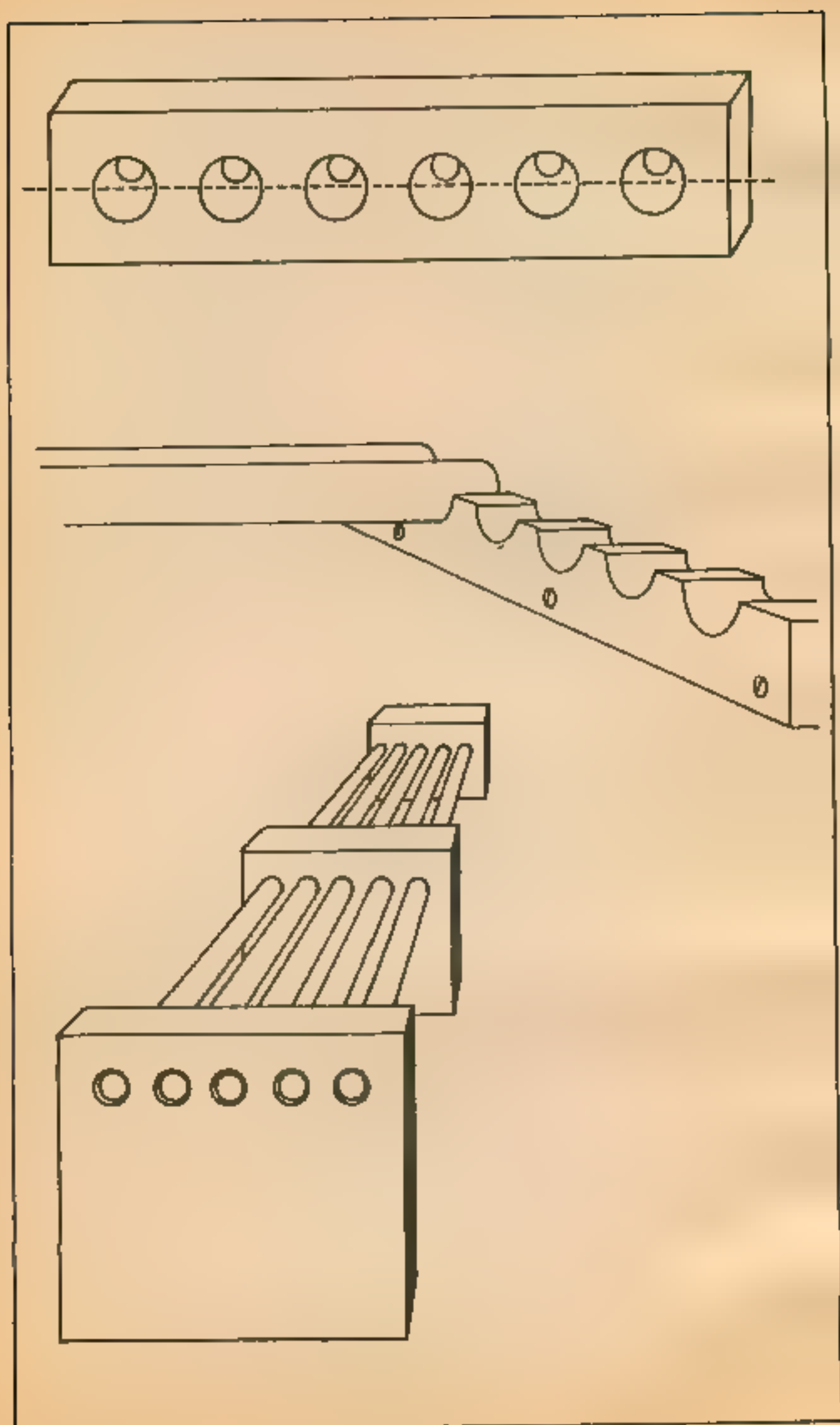
Or make a floor bench using two by tens or two by twelves of pine (redwood is great if you can afford it). Use a $15/16$ -inch drill bit for the holes. The tubing comes in ten-foot lengths, so that's the limit to size. Use three pieces of wood for strength.

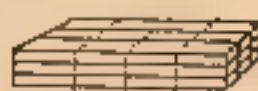
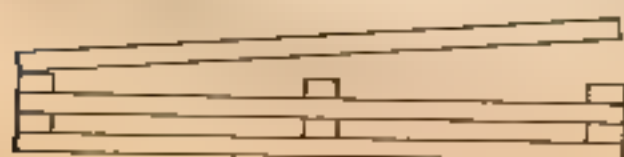
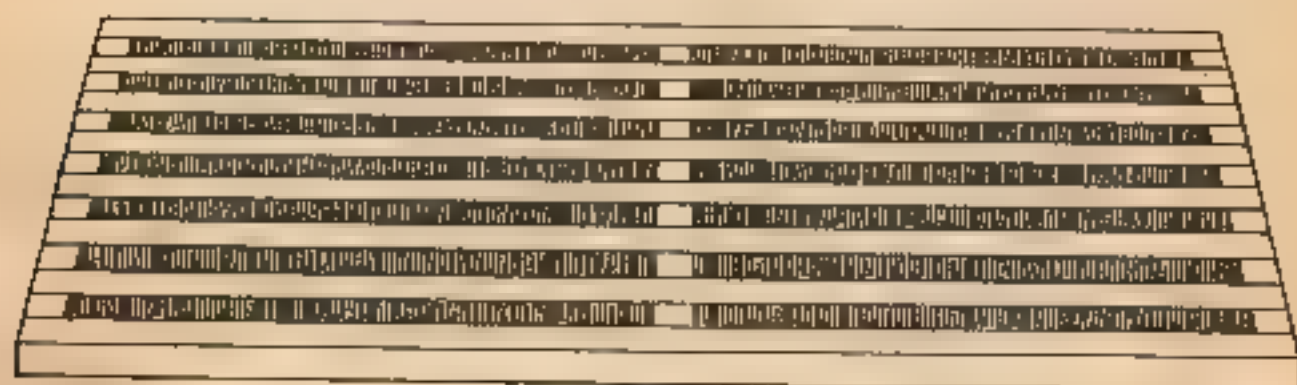
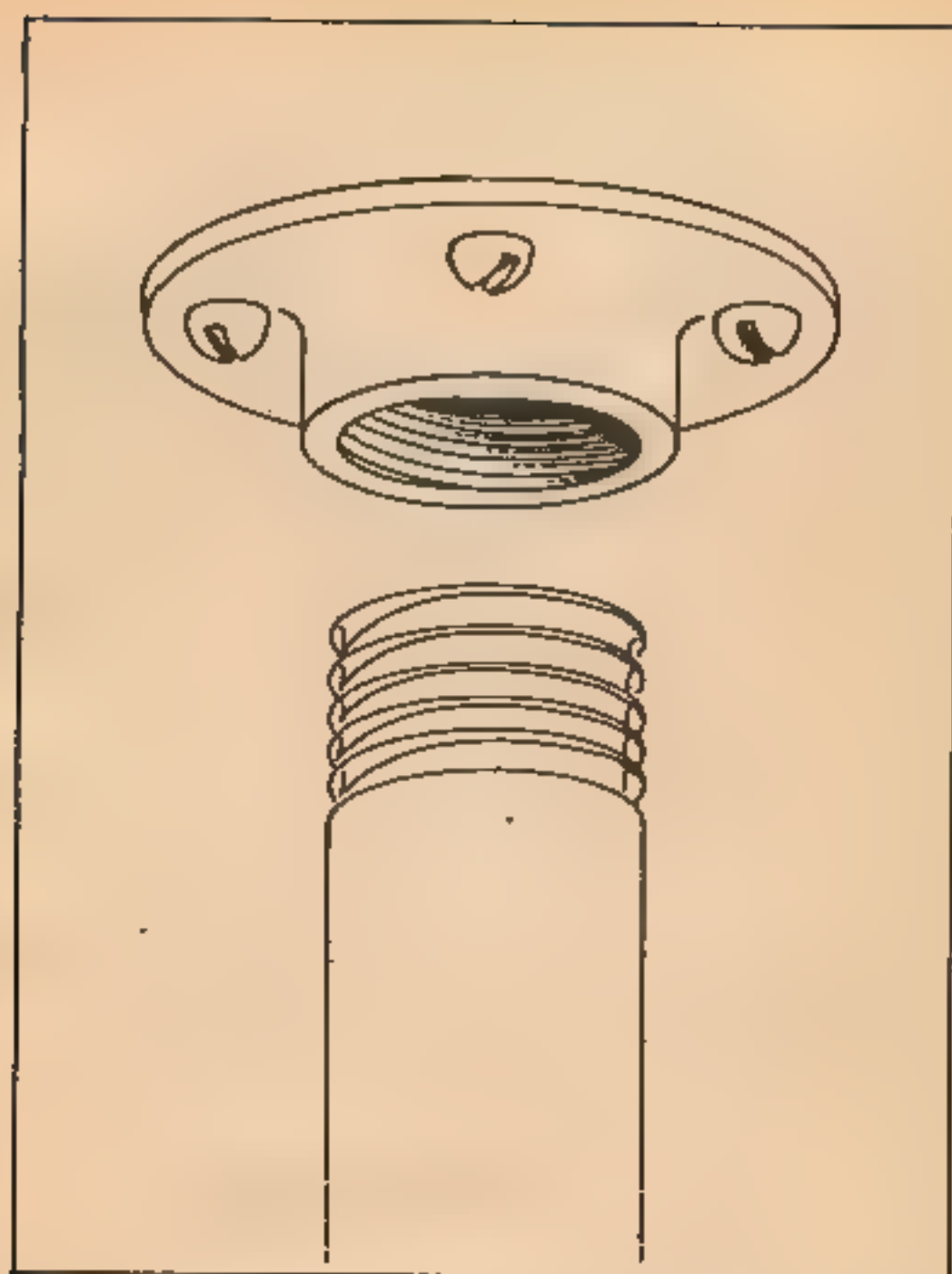
To secure the tubing from moving, use a $5/64$ -inch twist drill and drill a hole from the top of the wooden supports, down through each tube, and drop in a 4d nail.

Another great bench is very simply made from #2 grade pine one by two's (#2 means the wood has knots, but it's much cheaper than #1), galvanized finishing nails, size 4d, and glue. Bunch a number of one by twos and cut a large number of spacers at one time, about three inches long. Nail and glue three spacers (more, if you are making a bench longer than six feet) to a piece of one by two. Now just continue the process until it's as large as you want it. To finish it off, use a router for rounding the edges, and paint with three thin coats of marine varnish, sanding with fine sandpaper between each coat. I've had a set of these benches for over three years, constantly exposed to water, and they're still in perfect shape.

For legs, use aluminum legs from the hardware store, or four lengths of $3/4$ -inch pipe threaded into pipe flanges that are screwed to the base; or make saw horses from two by fours and folding metal clamps made for this purpose.







CHAPTER THREE

Down to Earth

The purpose of soil is to hold up the plant and provide it with air, water, and nourishment through a healthy root system. As we have seen earlier, the soil must be porous enough to allow for the entry of air, the passage of water, and to provide minerals for the plant. Because the requirements for plants differ according to their native environmental needs I have devised a number of individualized potting mixes which are referred to in the cultural instructions. While backyard soil might be great for weeds and grasses, it's not particularly suited to a jungle fern or barrel cactus.

Potting Sheds

If you have any available space, it's always an excellent idea to set up a potting shed. Nothing fancy—just an area where soil can be mixed in advance and stored in marked containers and pots stacked for future use, then if some dirt winds up on the floor, nobody gets too upset. I know from personal experience that mixing soils can get messy. A common place for tools is also needed, so the endless walks from room to room, looking for one small item, can be avoided.

POTTING MIXES

The following is a list of the readily available items that may be used to prepare a soil mix

- Aquarium gravel, found in pet shops, comes in many

colors as well as sand-colored or white. It's a great item to keep on hand, especially if the sand bank is frozen solid

- Bird gravel can be bought in pet shops or super markets. It's a tooth substitute for birds, but once again, handy to use in lieu of sand.

- Charcoal is another aquarium supply item. It's used to keep soil from becoming rank, by absorbing obnoxious odors from decaying vegetation, especially where soil is moist or wet, as in terrariums. I've always used it as it's been cheap up to now. Since I've not been bothered with odors, I assume it works

- Humus is the residue of the compost heap. It is well-decomposed vegetation that is black, sweet-smelling, loose in texture, and a marvelous material for plants

- Leaf mold, which is natural compost from the forest floor, is a very desirable addition to soil mixes because of its high organic content from decaying plant material. When gathered under evergreens, it's on the acid side; from hardwoods, tends toward the alkaline

- Loam is the catch-all word for good garden soil containing clay, sand, and humus.

- Osmunda is made from the roots of the cinnamon fern (*Osmunda cinnamomea*) and has for years been considered the one material for growing orchids because it has organic value. Today it is rarely used by big commercial growers because of relatively high costs, and tree bark is used instead, although plants grown in bark require additional fertilizers. Osmunda is used with many epiphytes, such as bromeliads, and can also cover drainage holes in clay pots when you can't find a piece of crockery.

- Perlite is made from volcanic rock that is commercially perked in a giant pressure cooker. It has no nutritive value, but helps to aerate heavy soils.

- Peat, sold by bag or bale, is the organic residue of many different kinds of plants that have become decomposed in water. Sphagnum moss may form part of its content, but never all.

- Peat moss is partially decomposed sphagnum moss that

will loosen a hard-packed soil, add nutritive value as it continues to decompose, is on the acid side, and a chore to moisten if it is completely dried out. Pour boiling water on it, allow to cool, and squeeze out the excess moisture.

- Sand is one of the main constituents of a good soil since it helps to make heavy soils more porous. Use builder's sand or sharp sand, being sure to wash it before use. "Sharp" simply means that the sand grains are rough to the touch as opposed to soft sand which is generally too fine to be useful. Beach sand is too full of salt and is also soft.

- Sphagnum moss identifies several different kinds of mosses that grow in bogs and swamps, spreading rapidly as they grow. The older parts below turn into peat moss. It is extensively used to germinate seedlings and as a growing medium for bog plants. It is acidic and when milled or pulverized is just as hard to moisten as peat.

- Store-bought soil is fine for part of a mix, but the cheaper types pack down too readily and the better varieties are just too expensive compared to the cost of mixing your own. Always keep a bag around for emergencies.

- Vermiculite, a very lightweight material, made from expanded mica, is useful for growing seedlings and to break up heavy soils. I use it for a soil replacement in combination with special pots for water or soil-less culture. Vermiculite is also sold by the bag for insulating house walls, but this kind consists of very large pieces that are not too workable for the indoor gardener.

The following are listed separately because they are more readily identified as fertilizers but are not made from chemicals. We'll discuss chemical fertilizers later in the chapter.

- Bone meal is a good old-fashioned source of phosphorus especially liked by bulbs and cacti. It is slow acting and organic. Superphosphate, manufactured commercially, is faster acting and more powerful.

- Chicken manure should not be used by a heavy hand, especially when fresh as the nitrogen content is so high that the roots may get first-degree burns.

- Cow manure should also not be used when fresh. When composted it is a welcome addition to soil mixes. It has slightly less nitrogen than sheep manure and for obvious reasons relating to production, is slightly cheaper.
- Dried blood is found with the manures in garden shops. It is supposed to keep rabbits and deer away from outdoor gardens but does not faze them in the least. It has a lot of nitrogen but I believe that the manures are better.
- Eggshells are a very good and ready source of calcium, about which more later.
- Sheep manure can be used when composted. It has a bit more nitrogen than cow manure and is more expensive.
- Wood ashes are a good source of potassium, sometimes called potash. Potash is the term for potassium compounds and can be gathered from the fireplace.

These definitions cover about everything needed to make good soil mixes. The cultural instructions given later in this book mention a correct type of potting soil for each plant. The following formulas are for general use.*

All-purpose mix for general potting where specific requirements are not given:

- $\frac{1}{4}$ loam or packaged soil
- $\frac{1}{4}$ sand
- $\frac{1}{4}$ leaf mold or peat moss
- $\frac{1}{4}$ composted manure

Depending on the amount you are making, add up to a pint of bone meal for a bushel of soil.

Tropical plant mix:

- $\frac{1}{4}$ loam or packaged soil
- $\frac{1}{2}$ leaf mold or peat moss
- $\frac{1}{4}$ sand

* If you have an unidentified plant and have no idea where it came from, examine it closely and you will be able to judge what type of soil to use. Plants with fibrous roots, thin leaves and weak flexible stems will do well in the all-purpose mix; plants with heavier stems, thicker roots and/or aerial roots and substantial leaves with a slight gloss should go in the tropical plant mix; plants with very thick, fleshy leaves, thorns, and heavy stems probably belong in the cactus and succulent mix.

Cactus and succulents:

1/4 loam or packaged soil

1/4 leaf mold or peat moss

1/4 sand

1/4 gravel or small pieces of broken pots

Depending on the amount, add up to a pint of bone meal per bushel of soil.

Terrarium mix:

1/4 humus or leaf mold

1/4 sphagnum moss

1/4 peat moss

1/4 sand and gravel

SOIL-LESS MIXES

There has been a new development in the past few years that may meet your soil needs. It's called the soil-less mix. The basic ingredients are inert mineral and organic derivatives with the addition of nutrients. Although the recipes look as though you must have a chemist's degree to put them together, the ingredients are readily available at garden centers and the drug store, and easy to keep on hand. They were developed at the New York State College of Agriculture at Cornell University to help commercial growers, but are easily adaptable to home use. They are particularly recommended to the city dweller who doesn't have sufficient working space or sources for soil, and the fact that spilled mix is clearly vacuumed up has much to recommend it. Roof gardeners take note, as the mixes are very light in weight.

The measurements below will each make one bushel of mix.

Cornell Foliage Plant Mix.

1/2 bushel	Sphagnum peat moss
1/4 "	Vermiculite, No. 2
1/4 "	Perlite (medium fine)
8 tablespoons	Ground dolomitic limestone
2 "	Superphosphate (20% powdered)
3 "	10-10-10 Fertilizer
1 "	Iron sulfate
1 "	Potassium nitrate

This foliage plant mix is well suited for ferns, amaryllis,

begonias, cissus, citrus, coleus, oxalis, pilea, sansevieria, and tolmiea

Cornell Epiphytic Mix:

1/3 bushel	Douglas fir bark (fine grind)
1/3 "	Sphagnum peat moss (shredded)
1/3 "	Perlite (medium fine)
8 tablespoons	Ground dolomitic limestone
6 "	Superphosphate (20% powdered)
3 "	10-10-10 Fertilizer
1 "	Iron sulfate
1 "	Potassium nitrate

The epiphytic plant mix is suited to bromeliads, episcias, hoyas, monstera, nephytis, potohos, and syngonium.

A supplemental application of a water soluble fertilizer—a 20-20-20 formula—should be given once a month (described later). Plants growing in full sun should receive about one third more fertilizer than those grown in the shade. During winter months in the north, only about half the amount should be used.

STERILIZATION OF SOIL

Anyone making their own soil mixes should be sure that the ingredients are free from disease. This is especially true of soils gathered in the garden or the woods. Not only does soil harbor beneficial bacteria, but also a host of other little pests, including insect eggs. You can spend an hour with a hand lens on one square foot of woods litter and have a constant parade of little beings that would thoroughly enjoy an epicure's vacation on a house plant. There are two general methods of sterilizing soil—heat or chemicals. It has been said that the odor of baking soil does the family an injustice. Perhaps if your group is a bit sensitive it's noticeable, but it's soon gone and not repellent in quality. On the other hand, the chemical most frequently used for soil sterilization is formalin, which is 40 percent formaldehyde and is extremely dangerous to have about the house. The odor is not only repellent but *ghastly*. Naturally, I recommend the oven method.

Spread moist, not dry, soil on a baking or cookie sheet and heat the soil for fifteen minutes at 185° Fahrenheit or 83° Centigrade. Use a candy thermometer to check

temperatures. This heat will kill fungus, insects, and weed seeds without harming the beneficial bacteria.

FERTILIZERS

Before discussing fertilizers for your plants, remember one axiom: Don't overdo it! We all have a tendency to try to make a good thing better; that's a natural part of the human condition, but it's one thing to achieve a tenfold increase in corn yield or produce the biggest cabbage in the world, earning a place in the *Guinness Book of Records*, and quite another to bombard a helpless pot plant with too much food. Since most of us don't have the room for giant plants to begin with, especially as our collecting mania soon fills all available space, it's better to keep a plant in good condition rather than making it bend at the ceiling. Certainly some feeding is a desirable thing, but if our potting mixes are correctly suited to the particular plant, it doesn't take much food to keep it healthy.

Plants need three elements for healthy growth, and a number of trace elements in minor amounts. The big three are nitrogen, phosphorus, and potassium.

Nitrogen is beneficial to the healthy growth of shoots and leaves. It's absolutely necessary for forming a plant's supply of chlorophyll. Without nitrogen the plant's growth is restricted, the root system becomes stunted and the leaves yellow and fall off. However, too much nitrogen results in an excessive leaf growth (at the expense of flowers) and long, spindly stems.

Phosphorus helps a plant to develop flowers and healthy roots and to resist many diseases. Without it, lower leaves yellow and drop off and yellow edges develop on the upper leaves.

Potassium acts as a balance between the other two; it delays the maturing, undue ripening effect of phosphorus and it slows the tendency to overgrowth caused by nitrogen. When potassium is lacking, leaves turn dry and scorched around the edges.

(Most of these symptoms can be caused by other factors such as temperature, improper watering, and disease, so check these first before increasing fertilizers.)

Good plant foods are measured in percentages of these three elements. A typical formula would be 5-10-5: 5 percent nitrogen, 10 percent phosphorus, and 5 percent

potassium. It doesn't add up to 100 percent because these chemicals are so powerful that a large amount of neutral substances have been added to the mix. These percentages can easily be varied, and large feed and fertilizer concerns will mix any formula one could want. But we're dealing with house plants and not jumbo rye, so unless your soils are woefully bad to begin with, or you're experimenting on a big scale, stick to something simple in order to cut down on the general complications of life. I use a standard 20-20-20 formula for established plants, and a 10-10-10 (the same but a weaker formula) for seedlings. In addition, I always cut the mixing directions by half, just to be on the safe side. The trace elements that were mentioned previously as necessary to good growth, are usually added to the better commercially prepared mixes.

Keep away from gimmicks like pills and capsules that are buried in the soil. They release chemicals whenever you water, whether the plant needs it or not, and once implanted are a bit difficult to remove.

A few rules:

1 Don't feed a plant when it's blooming. The very fact that it is flowering means you were doing the right thing to begin with, so it's best to stop until blooming is over. If the plant is a long-term bloomer, just slow down the applications.

2 Don't feed when plants are resting or dormant, especially during the winter months up north.

3 Don't flood an absolutely dry soil with fertilizer. The roots are tender and could suffer from burning. This isn't likely when foods are diluted enough, but it's a good habit to get into.

4 Actively growing plants need more food than slow-pokes, but don't feed if there is not evidence of growth.

5 Don't feed a plant that is suffering from a disease.

6 If your pots have a healthy growth of algae on their sides, or the top of the soil exhibits a white, granular aspect, the chances are the plants are getting too much food.

After repotting, I generally wait a good six months before beginning applications, then I apply weak solutions every three weeks or so.

If any plant has a specific feeding demand, check the cultural instructions.

pH

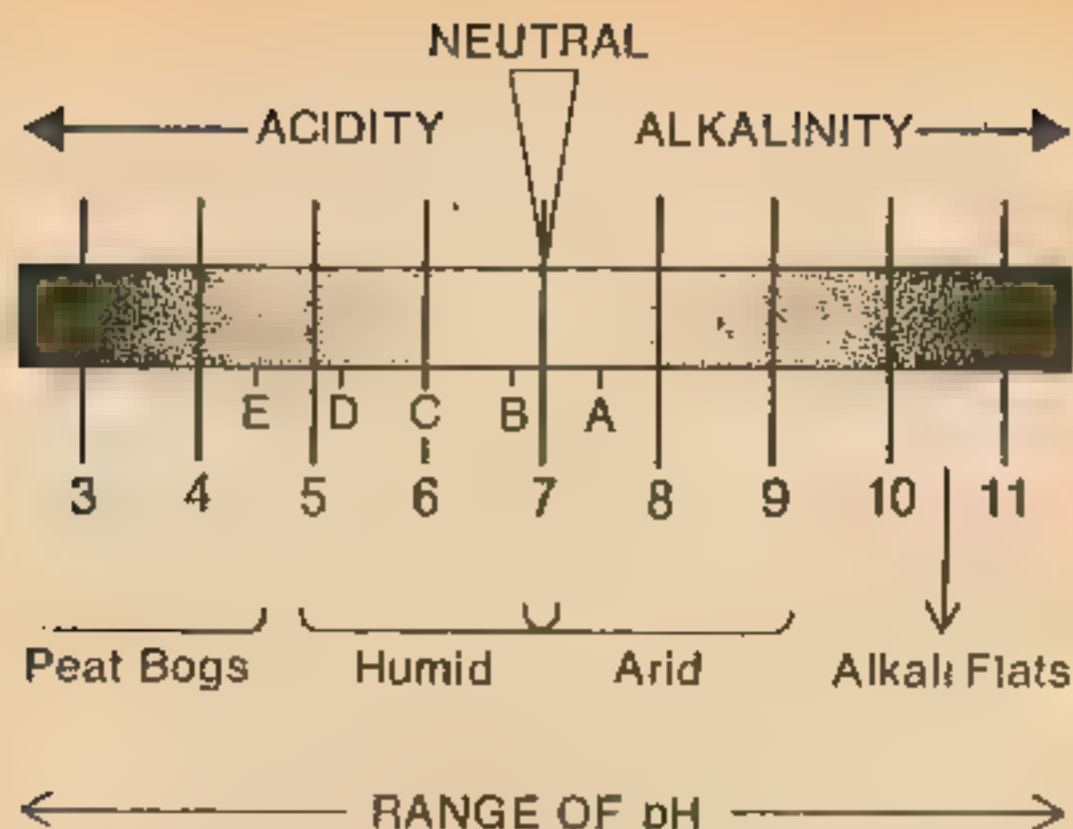
pH is a term consistently bandied about by indoor and outdoor gardeners, but is very rarely explained to anyone's satisfaction. It has the aura of chemistry so we either go overboard and test everything we can get our trowels into or completely ignore it in hopes it will go away. Unfortunately, it's important to the health of a great many plants. True, some will survive in improperly balanced soils, but it often spells the difference between luxuriant growth and just bare survival.

Literally pH means the potential for hydrogen or hydroxyl ions in the soil.* Practically it's a test to determine the relative acidity, or sourness, and alkalinity, or sweetness, of soil.

Every time it rains, the action of water washes out accumulations of elements in the soil. One of these elements is calcium and, as it disappears, soil becomes more acidic. It's an extremely slow process in nature but over the years definite patterns of soil type have developed throughout any region. Swamps and bogs that have high percentages of peat are extremely acidic; in humid regions, and most woods and forests, the soil is moderately acidic to slightly alkaline, arid regions go from slightly moderate to a strong alkaline content, and desert areas in the southwest of the United States have vast alkali flats.

The chart below is a measure in units of 3 to 11. Neutral soil is 7 and most plants grow between ranges of 4.5 and 7.5.

* The chemical formula for water is H_2O . The molecules of water ionize slightly into hydrogen ions with a positive charge (H^+) and hydroxyl ions with a negative charge (OH^-). Hydrogen ions are acid and hydroxyl ions are alkaline. Because equal numbers of the ions are formed for each molecule of water, water is acidic, basic and neutral. On the logarithmic scale of pH, pure water is pH 7, or neutral. Alkaline solutions or soil contain less hydrogen ions and more hydroxyl ions; acid soils are just the reverse.



Each unit up and down the scale is measured in a tenfold increase or decrease from point 7. Four would be 1,000 times as acid as 7. 9 would be 100 times as alkaline.

By comparing the letter code in the following list to the pH chart, you can see the amount of variations found in this sampling of flowering plants grown in and around the home. A complete list of plants and their pH rating is in the Appendix.

African violet	B	Hydrangea, Blue	E
Ageratum	B	" Pink	C
Amaryllis	D	Lily	C
Avocado	B	Morning glory	A
Banana	B	Nasturtium	A
Begonia	C	Orchid	D
Calendula	A	Petunia	A
Clematis	A	Pitcher plant	E
Cyclamen	C	Rhododendron	E
Daisy	B	Star of Bethlehem	B
Fuchsia	B	Tulip	B
Gardenia	C	Zinnia	B
Heliotrope	A		

Years ago, pH was not considered to be very important in raising house plants. Greenhouse gardeners with the responsibilities of huge and valuable commercial crops were aware of the soil demands of their charges, but the

typical house-plant enthusiasts were generally unaware of pH. They knew through trial and error that certain soils worked for certain plants. Varieties were few, but their begonias, geraniums and ivies were beautiful. When visiting your friends and admiring their plants, quite often you'd get a present of a plant or a cutting. "What do I pot it in," you'd ask. "Oh just about any dirt will do," came the reply. Talk would then turn to the problems of the day and just as you would leave a voice would cry out: "Oh, by the way, remember to add a few crushed eggshells to the soil every so often!"

Grandmother had the secret. Eggshells are a fine source of calcium. By crushing the shells and adding a pinch to the soil surface, she had paraphrased today's 'tiny, time capsules' which release small and continuous amounts of calcium offsetting the natural acidity of soils. Since most house plants prefer between 6 and 7.5 on the pH scale, healthy plants were the result.

Except in our more modern kitchens eggshells are still available. Collect them, air dry them, and pulverize them in the blender. If you have an old-time mortar and pestle and a willing wrist, it works eminently well or simply fold the shells in a newspaper and attack with a rolling pin. Just add a generous pinch of crushed eggshells to the soil every few months.

The obvious time to check pH is when working with a healthy plant at the time of repotting or when dealing with native plants brought in from the woods and fields. By looking at the pH preferences of some typical plants, you will see some notable exceptions to the general range of 7.5 to 6. The acid preferences of bog plants and insectivores or the alkaline demands of cactus would produce an unhealthy zinnia or heliotrope. Also, while generalizations can be made concerning soils around the United States, there are wide fluctuations on the local levels.

There are two fine testing kits for pH on the market today. The Sudbury Soil Testing Kit is complete and perfect, both for the amateur chemist and the purist. Not only can you check pH, but the soil content of nitrogen, phosphorus, and potassium. The other kit is a variation on litmus paper, a dyed paper strip made from, of all things, lichens. It reacts by color to pH and comes in a small plastic cassette. Made by the *Perfect Garden Company*, it's too handy not to have.

We've talked about the acid content of soils, but what about moving an alkaline soil down the pH scale to the

acid range? This condition is not very common but if it does occur, the addition of aluminum sulfate or alum salts to the potting mix will solve the problem. It's best to get one of the pH kits and follow their instructions rather than hit or miss application of chemicals.

We are not finished with pH yet. It affects not only soil but water. Soft water is generally free of mineral salts and leaves the bath tub ring free. It's acid in reactions and the best source is rain-water. Hard water is alkaline and has heavy concentrations of calcium and other minerals. Soap forms curds in hard water.

Now, you ask, didn't we just finish adding calcium to the soil to offset its acidity? Yes, but in small amounts. When watering with hard water, we continually add these salts, day after day, and it's not too long before the soil becomes so saturated that a dull, gray film will form on the leaves of many plants that is unattractive and cuts down on available light. Since hard water can be softened by boiling (thus leaving the mineral salts in the kettle) or using rainwater, it's easy to control. Better to limit your problems to the soil and forget the additional worry of hard water. Don't use water softened by commercial water softeners. They exchange the calcium for sodium, and while the water becomes kind to your hair, it slowly kills the plants. This does not happen overnight. Slowly the plants become stunted in growth and, if unchecked, eventually die.

CHAPTER FOUR

Pots and Potting

ESTHETICS OF POTS

Unfortunately there are two words synonymous with pots. One is clay, the other is plastic. Clay is a time-honored material with a long cultural history; plastic is a Frankenstein's monster, conceived in the thirties, and now out of control.

When our descendants search the rubbish piles of today, a thousand years hence, not only will they find beer cans, throw-away bottles, and cutesy deodorant containers, but they will dig up millions of plastic flower pots, many with imitation 14-carat-gold rims.

No one would dare to frame a Rembrandt or van Gogh in a plastic frame studded with gold flecks and jazzy rhinestones, except perhaps in a Las Vegas hotel. Then why put a real plant, the creation of millions of years of evolution, into an imitation clay pot with a cornflower decal?

Plastic and styrofoam pots work well for the commercial grower who has skyrocketing maintenance costs and who must meet deadlines for seasonal markets that are as hectic as the fashion industry. He has an excuse to use such pots because they are cheaper, his plants are grown on schedules and are in essence manufactured on an assembly-line basis, like cars and T V's. But you can easily remove the plant from its artificial container when you reach home. (I suggest using plastics in this and other sections of the book, but generally they are imported plastics which serve a function that cannot be achieved in clay.)

There are good reasons other than esthetic ones for

using clay containers. Clay "breathes," allowing air and water to pass through the walls. It's much more difficult to overwater when using clay. I'm convinced that more damage is done by lethal overwatering to house plants growing in plastic pots than any other mistreatment known. Furthermore, clay is much heavier and keeps larger plants from toppling in a mild breeze when outside or falling over because you brushed against it in the home. Clay will last much longer (as long as you don't continually drop pots) than plastic, which becomes brittle with age. By looking at the algae or salt deposits forming on the clay, you have an early warning system that predicts problems long before the plant itself shows signs of trouble.

An empty clay pot can sit alone on a shelf and make an esthetic statement. A whoopy-do plastic zinger of a pot speaks harshly for itself.

CLAY POTS

Clay pots are made in many different sizes and shapes. They start at 2 inches, measured by the diameter across the top, and go up to 16 inches or more. Their height is about the same as the diameter. Many have names long associated with English gardens. The 2-inch pot is called the "thimble," the 2½-inch pot the "thumb." When the height exceeds the diameter they're called "long Toms"; when shorter than they are wide they are called "dwarfs." You'll also find azalea pots which are three quarters of the standard depth, allowing for shallower root systems.

I rarely find a use for the thimble and thumb pots because they are so small, the soil dries out too quickly, but they're fun to have around for an extra small cactus or a conversation piece. It's difficult to believe that one can make a pot so small. Before peat pots and Jiffy-7's were developed, these small pots were extensively used for seedlings. Now we transplant the beginning seedlings and their peat pots into three-inch clay when the plants are big enough. Depending on the age of the pot and the manufacturer, you'll find minor variations in the thickness of the clay walls and top measurements.

New clay pots are bone dry and must be thoroughly soaked in water before use, or they'll quickly draw most of the water from the soil. Old and reused pots must be cleaned and scrubbed. Steel wool will easily remove an accumulation of mineral salts.

Drainage holes are found in the bottom. These should be covered with a few shards of broken pot to keep soil from escaping and, if your plants are outside or in a greenhouse, a small piece of screening to guard against wandering slugs and other undesirables.

Never paint pots. If you want to make an attractive display for a beautiful plant, find a suitable jardinaire or other container and place the clay pot within.

POTTING

When a plant needs repotting, it's only moved up one size, at the most two. A small plant in a large pot not only looks rather strange, it usually does not last too long. Unless plant roots extend throughout the soil, the excess becomes soggy and compacted leading to sickly growth.

Re-potting becomes necessary when the roots completely occupy all the soil and the root ball assumes the shape of the pot. The first sign is roots working their way through drainage holes. The best time for repotting is early spring when plants begin active root growth after a winter's rest. The worst time is during winter, because broken roots have a smaller chance of healing quickly before disease can set in. An actively growing plant can be repotted at any time.

If you are worried about a plant being potbound you can easily check without hurting it. Place two fingers, one



on either side of the stem to hold the soil and flip the pot over. Rap it on a hard edge and the soil ball should slide out. Wait until the plant's soil is fairly dry for this routine, soaking wet soil will fight you all the way.

If all looks okay, and the roots are not massed on the outside, pop the plant back in the pot. If not, move up to the next size.

Take your larger pot, crack it, sprinkle some new soil on the bottom and place the root ball on top. Sprinkle new soil about the sides and give the pot a sharp thump on a table or the floor to help settle the soil. Firm the edges with your thumbs and the job's done.

One important thing to remember, leave enough room at the top of the pot for watering. With a five-inch pot, there should be at least a three-quarter clearance between the rim and the soil. Nothing is quite so aggravating as watering a plant, dribbling mud down the pot side, then having to go at it again because in the first attempt the plant got half and the floor got the rest.

After potting, water the plant well to help in settling the soil. If you packed it a bit on the loose side, you'll notice a few depressions. Just sprinkle some more soil in them to level the surface. I always add a small shard or flat stone to the surface to break the force of water when it leaves the watering can.

When watering a plant, the pot sits in a saucer to catch the excess water. If there is no room between the water and the pot bottom, the water seeps back in. This is fine with many plants, but some resent it. Set the pot on a few pebbles, or large pieces of gravel, and make sure the saucer is large enough to take the water without overflowing. The slow evaporation from the saucer will add to humidity and save the time devoted to emptying saucers after watering.

Root Pruning

Sometimes you have a plant that is obviously potbound; yet you feel that both plant and pot are large enough and you would like to maintain status quo for a time.

Remove the root ball and set it on your work surface. Take a large, sharp knife and slice off about half an inch of soil and roots. Then repot as before adding new soil around the edges. Then prune the plant itself slightly. Don't overdo it. Since the plant just lost some roots that

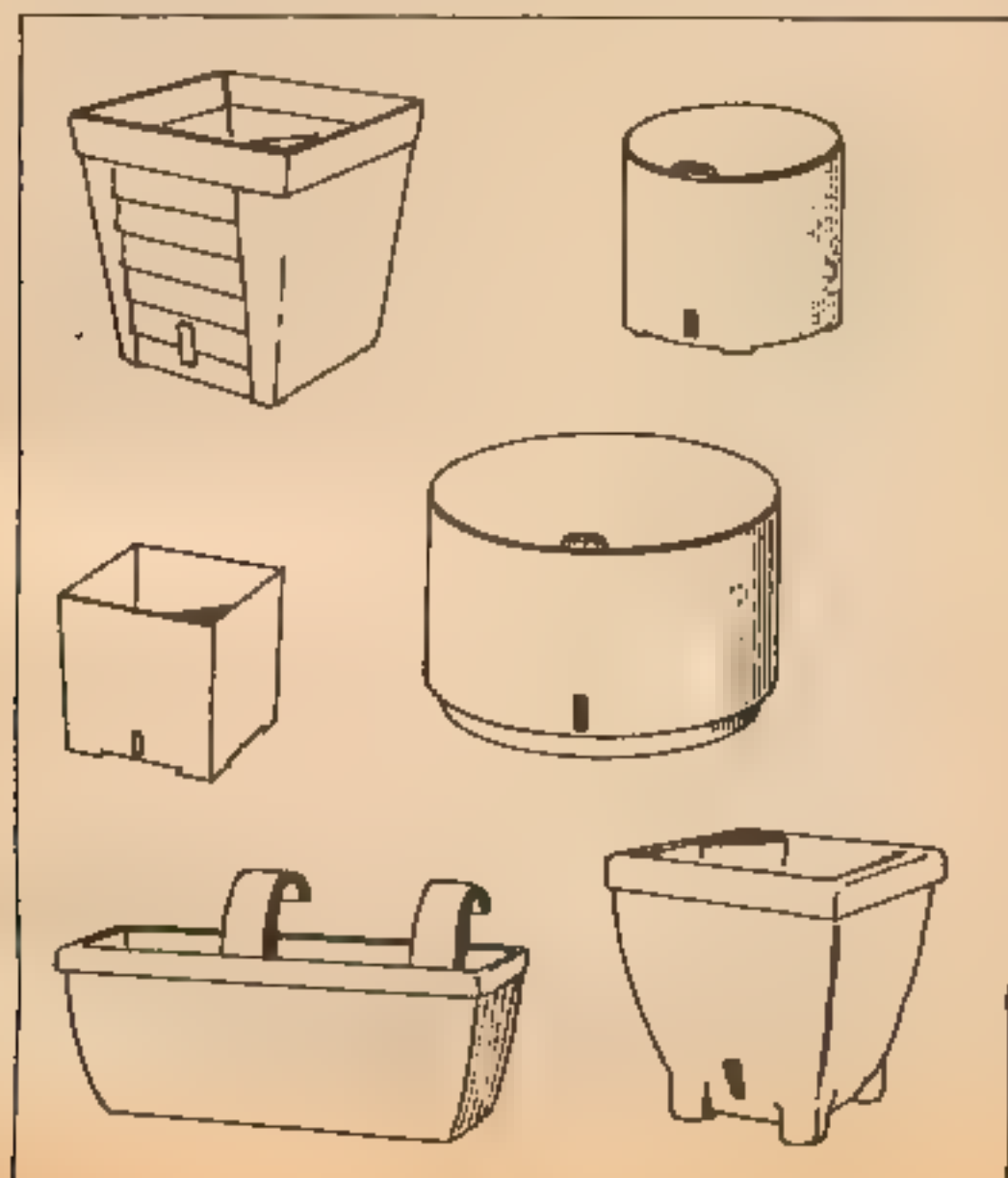
were obviously in use, make its job a bit easier by giving it less top growth to supply with water and such.

Top Dressing

Suppose you have a truly potbound plant no extra pots and no time to become overly involved with potting. Remove about an inch of the surface soil and replace it with new potting mix. As you water the freshened soil will help the roots along and stave off the inevitable for a while. Occasionally the pot will break from the pressures of the roots, and you'll be forced to repot it.

SELF-WATERING POTS

I've made my position against plastic pots very clear, but I'm allowed a few exceptions: the Riviera self-watering pots. Made in France of molded plastic in attractive colors, this device allows you to be an absentee plantlord without worry. A nylon fabric held by a plastic grid sup-



ports the soil and provides water from a reservoir with a nylon wick. The soil grid is held above the water level by a hollow tube that allows a continuous flow of air to reach the root system. If the reservoir is filled and the plant located in a cool, well-ventilated spot, you can leave home for at least three weeks. By covering the topsoil with aluminum foil, you can stay away even longer.

By adding fertilizer to the water, and using a soil-less mix of vermiculite and peat moss, many plants grow beautifully as hydroponic subjects.

The pots are available in many variations, from small to large planters, troughs, flats, and hanging-balcony troughs.

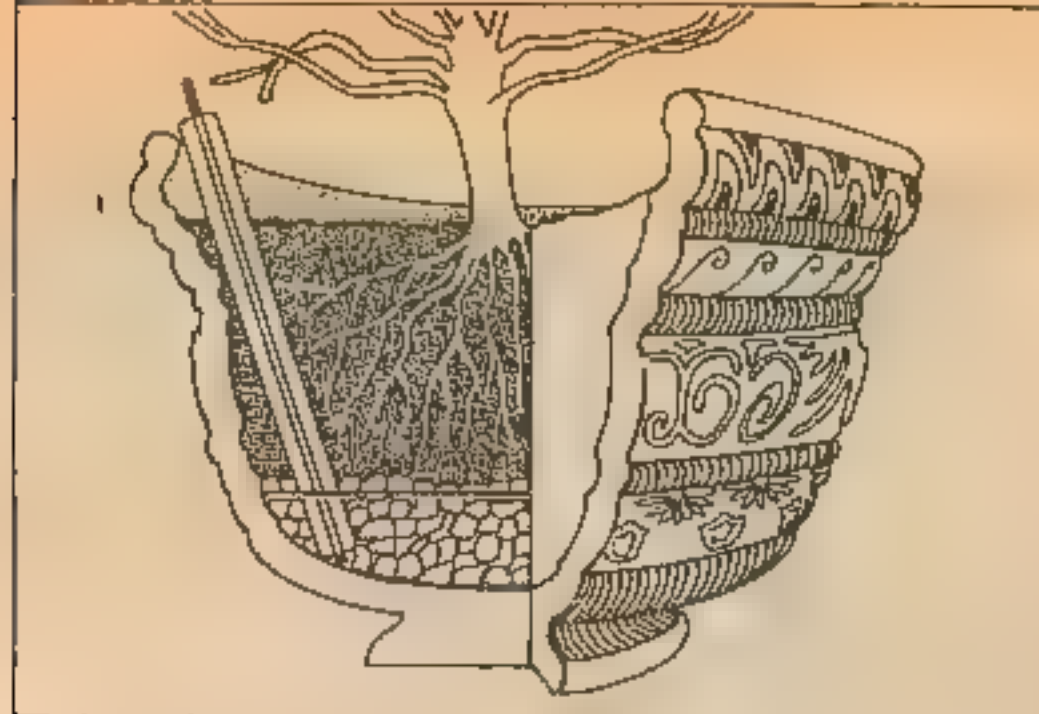
There are other self watering pots on the market today, but from my point of view, they are either too ugly or they work on the principle of a pot sitting directly on a wick or spongy surface. This you can easily do on your own, so why bother? Also, wicks inserted through the drainage hole cut off air circulation to the bottom of the pot.

A water wick is manufactured by Mardon Gardens that works through the soil surface. One end is placed in a glass of water and the other inserted into the soil. It works on capillary action but is not advised for plants that like dry soil, or plants that require a dry period between each watering.

Since a great many people are insulating their houses today, those hardier folk could take some excess fiberglass and weave their own wicks. Personally, I've had enough of fiberglass slivers in my hands and hair. I'll purchase the wicks outright.

Pots Without Drainage Holes

You might have an especially attractive container around the house that you'd love to use for a decorative plant, but the pot has no drainage holes and you're worried about overwatering. Here's a solution that really works. At any store that sells tropical fish, buy a piece of plastic tubing the height of your pot. Set it within the pot in an upright position and add between two and three inches of coarse gravel, making sure the tube hits the bottom. Add the appropriate soil mix and pot the plant, watering it fully. Using a wooden dowel as a dipstick, measure the water supply periodically, when the stick comes out completely dry, water again.



Pots Within Pots

If you have a plant you wish to display in a fancy waterproof container for a short time, cover the bottom of the container with a few inches of perlite and set the pot on top. The excess water will collect in the perlite, slowly evaporating, adding to the humidity and keeping the plant from soggy soil. If the container is large enough, a clean brick or a piece of two-by-four lumber will do.

If the plant you wish to display does best in moist soil, try this. Take your container and set the pot on a few inches of shards or clean stones. Pack the sides with sphagnum moss. The water from the wet moss will seep through the porous clay walls and keep the soil consistently moist, not soggy.

NOTE. In the other chapters in this book, through written description and illustrations I've attempted to show as many variations and ideas on pots as I could manage. Like the frames on a picture, each plant deserves its own particular container.

The full page drawing shows a group of plants that have been growing in a six-inch Riviera pot for well over a year. Liquid fertilizer (20-20-20) is applied once a month:

- 1 Chinese evergreen, *Aglaonema simplex*
- 2 *A. commutatum* Malay Beauty
- 3 *A. commutatum elegans*
- 4 Satin pothos, *Scindapus pictus argyraeus*
- 5 Devil's ivy, *S. aureus*



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CHAPTER FIVE

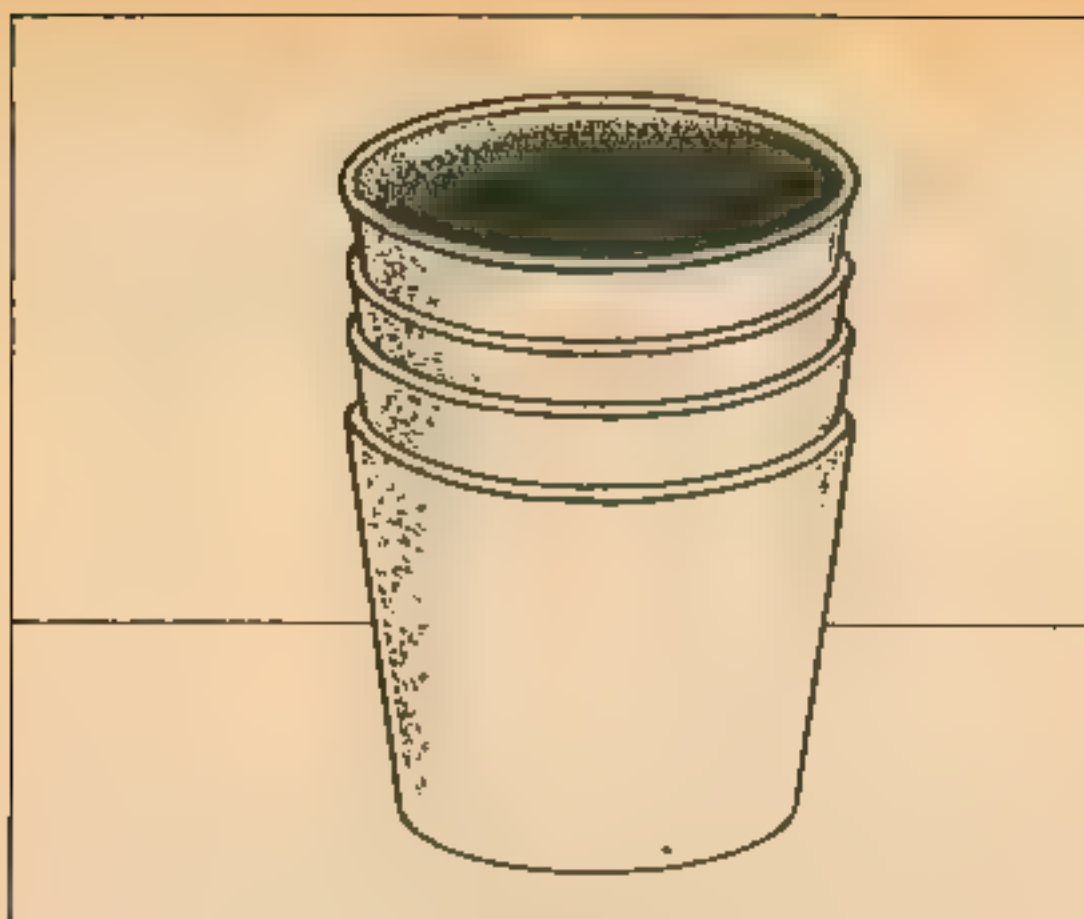
Seeds and Cuttings

Sooner or later, after becoming involved with growing plants, the collecting urge appears from left field and we begin to wish for more. When the urge strikes but the pocketbook rebels, the best and easiest solution is to grow your own plants from seed. In addition to being one of the easiest methods, it enables you to try many new kinds of plants, ordinarily unavailable from the majority of commercial nurseries.

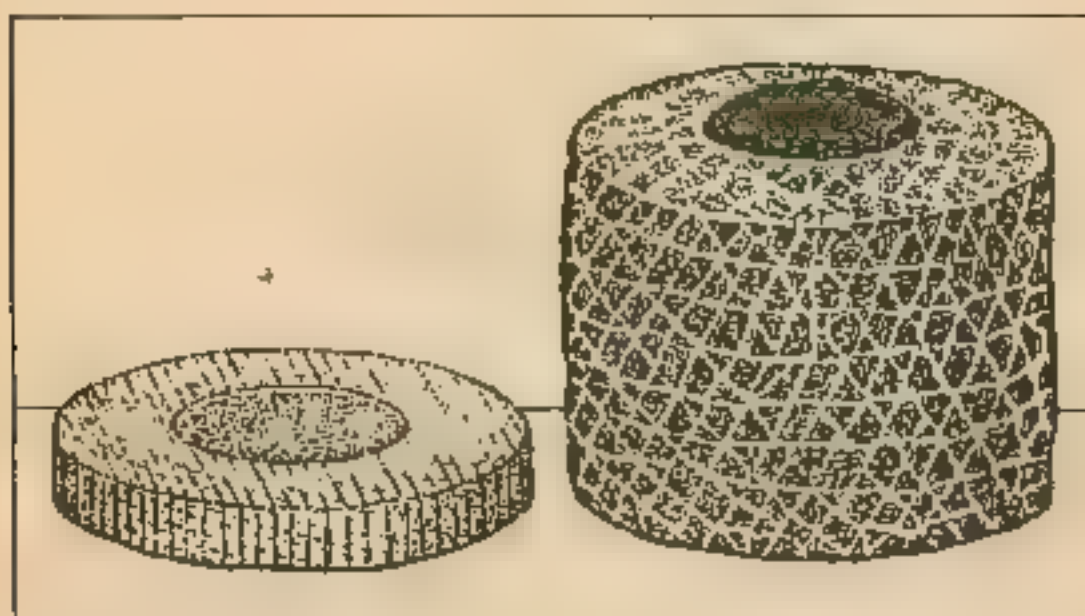
Most of the major seed companies now offer seed-starter kits that are almost foolproof, and an ever-increasing selection of house-plant seeds are available (see Appendix). Since so many varieties of equipment are offered and the selection is basically a personal choice, I'm just going to deal with the methods that I use.

As a seed-growing medium, sphagnum moss is my first choice. It's tidy and free of contaminating organisms. Furthermore, nonsterile mediums tend to favor the development of a fungus growth that destroys seedlings as they emerge from the ground in a process called *damping-off*. Either gather your own moss from a local swamp (see Chapter 6), allow it to air-dry, and shred it into tiny pieces with your hands, or buy milled sphagnum from the local nursery. "Milled" simply means that the shredding has been done for you. The disease organisms that cause damping-off are found in soils, so you do not have to worry when using moss.

For seed-growing containers, I use either peat pots or Jiffy-7's. Peat pots are good for small sowings when I intend to transplant the seedlings at a later date. If seeds are large, like nasturtiums or morning glories, and will go



from germination to potting without a transplant step, Jiffy-7's are perfect. They come flat for easy storage, but by adding water, they quickly increase to their proper size.



Jiffy-7's cost more, but their mesh construction allows them to be planted directly, as plant roots meet no obstructing wall. Peat pots, in my experience, do not break down as fast as reputed and will hinder small roots

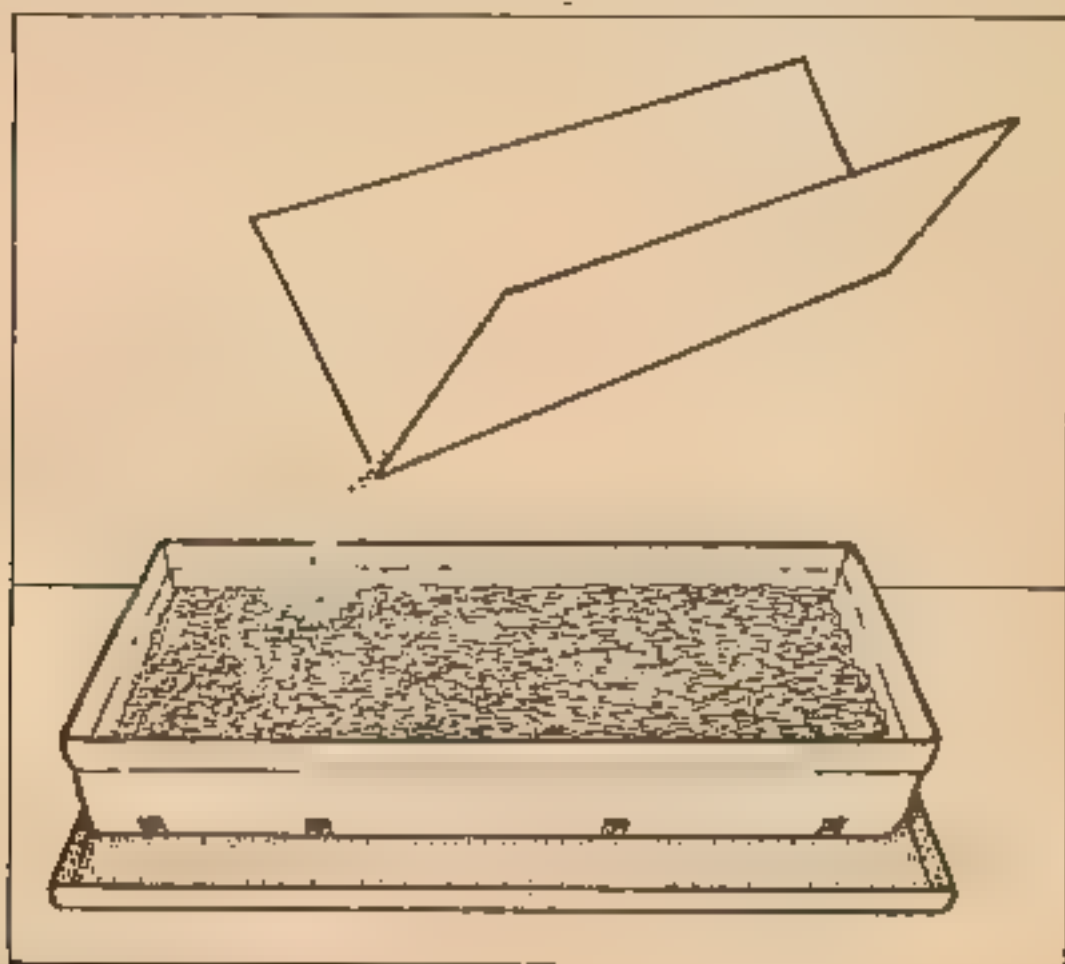
If a large crop of plants is your aim, then use seed flats made of pressed plant fiber.

When ready to plant your seeds in moss, take the moss and soak it in hot water, cold water takes longer to

penetrate the moss fibers. Let it cool, and squeeze out the excess water with your hands. The moss should be wet, but not dripping. Put the pots or flats on waterproof trays and fill to a depth of at least two inches. Tamp the moss down with the palm of your hand, but don't pack it tightly. Now you are ready to sow the seeds.

First read the requirements on the packet. Some seeds must have a period of cold before they will germinate. The process of exposing them to a temperature drop (which works out to be about 40°F.) is called *stratification*, simply store the seeds behind the Jello in the family refrigerator. Stratification is a safety factor built into seeds that grow in a northern climate. It prevents their germination during a January thaw. The instructions will tell you how long to chill the seeds.

If you are worried about how deep to plant the seeds, and the packet doesn't tell you, cover small seeds (one-sixteenth of an inch or larger) by the thickness of one seed. Tiny seeds, like begonias, need not be covered at all. When sowing small seeds, use a folded piece of paper and tap it gently as you move it across the moss.



Heating Cables

The single most important reason why many people have trouble with seeds germinating is that the seed bed is too cool. Lack of heat works in combination with the moisture

to rot the seeds before they can sprout. The majority of seeds must have warmth for germination to occur, usually between 65°-70°F. The solution is a waterproof, insulated heating cable coupled with a thermostat that is preset to 70°. These are purchased as a complete unit and sold by length. At the time of this writing, a twelve-foot cable capable of heating a growing area of four square feet is under five dollars. Seeds from tropical countries often require even higher temperatures, so should be started in the summer. The only way I ever got a mango to sprout was exposing it to the high temperatures of a compost heap where it sprouted in October after being thrown out.

Cover your planted containers with plastic wrap or glass, but keep it away from the surface of the moss as drops of moisture will condense (especially when using the cable) and form small swamps that will drown the seeds. This miniature greenhouse will prevent the medium from drying out—an event to be avoided at all costs! Keep the trays near a window, just out of reach of the sun's rays. A lot of sources tell you that complete darkness is necessary for germination but I've never found that to be true. In fact, many seeds need the stimulation of light before they sprout. A few seeds need total darkness, like the forget-me-not and poppy, but the seed packets will tell you.

When the first green shoots appear, move the trays into the direct sunlight (unless you are doing all of this in midsummer), turning them daily to keep the tiny plants from bending to the light. Remove the covering and keep a continual check on the water situation, the moss can dry out very quickly in the heat of the sun. When watering is needed, water directly into the tray until the seedlings are big enough to withstand the weight of water drops.

When the true leaves appear, I transplant to individual peat pots or Jiffy 7's. Using the standard soil mix. The pointed end of a knife or a plant label makes an excellent tool, just be as gentle as possible. Pick up the plant and lightly cover the roots with soil. It must be reasonably wet, but not mucky. If the plants are still tiny like begonias, I leave them in their original containers, but thin them out, allowing at least an inch between each. When they are slightly bigger, I thin again leaving only the largest plants.

The seedlings should not be moved into pots until they are at least three inches high.

(A few of the excellent books and government publi-

cations on growing plants from seed are listed in the Bibliography.)

ROOTED CUTTINGS

An effortless way to produce new plants is by rooting cuttings. It's faster than raising plants from seed, and the rooted plants have all the characteristics of the mother plant; seeds of many hybrid varieties available today do not always produce offspring with the same appearance as the parents.

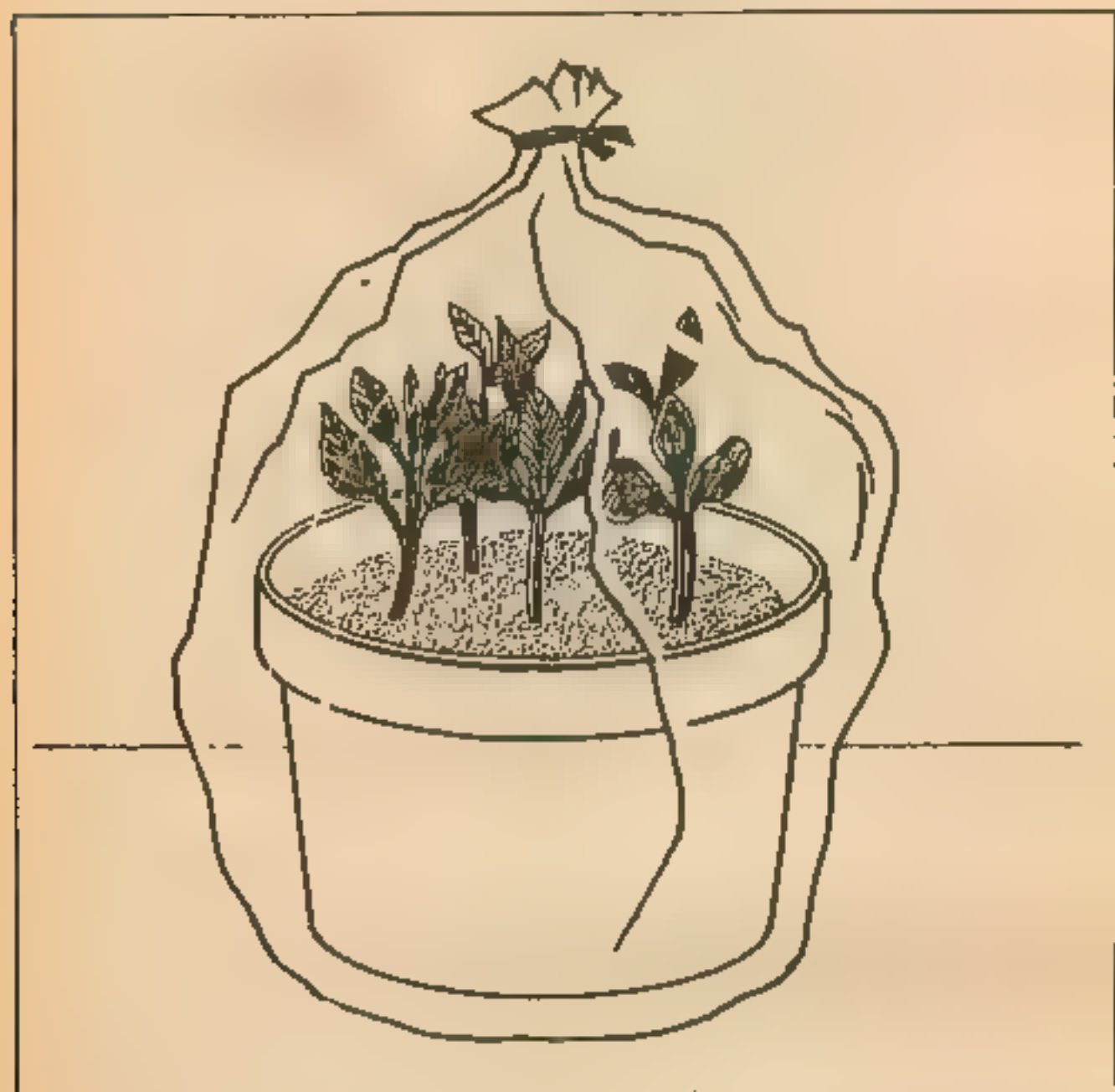
If only a few new plants are wanted, I've found the best method is a combination of Jiffy-7's and small plastic food bags. First choose a plant you would like to reproduce, especially if it's a favorite but has become tall and spindly with time. Choose healthy shoots about three to five inches long and cut them off with a sharp knife or razor blade slightly below the point where a leaf joins the stem. Remove any damaged leaves and flowers and neatly slice off a few of the bottom leaves close to the stem. Take an expanded Jiffy pot and make a hole with a pencil or similar object, three-quarters of the pot's depth. Insert the cutting, making sure that the base of the stem touches the bottom of the hole. Firm the soft peat back into place around the stem. Now put the whole affair into a plastic bag with the opening at the top. Unless the air conditions are very dry you need not seal the bag. In about two weeks, give the cutting a slight tug to check if rooting has commenced. If not, pull out the cutting and check the end for rot. If all looks well, try again, but make doubly sure that the base of the cutting touches the rooting medium; it needs this touch stimulus to start new roots. All this time, make sure that the pot is moist; never let it dry out. When new roots appear, poking through the mesh, plant the Jiffy-7 in a three-inch clay pot.

There are plant hormone products available to induce rooting, but I've never found the additional stimulation necessary, especially if cuttings are started in the spring of the year. When many plants are needed, I use a six-inch clay pot filled with shredded sphagnum moss that is evenly wet, but not soggy, and fairly tightly packed. Cuttings are inserted and the pot placed in a plastic bag. Once again, check on the moisture level of the medium periodically, and if the humidity is extremely low, put a Twistum on the bag. Plastic bags that are sealed should

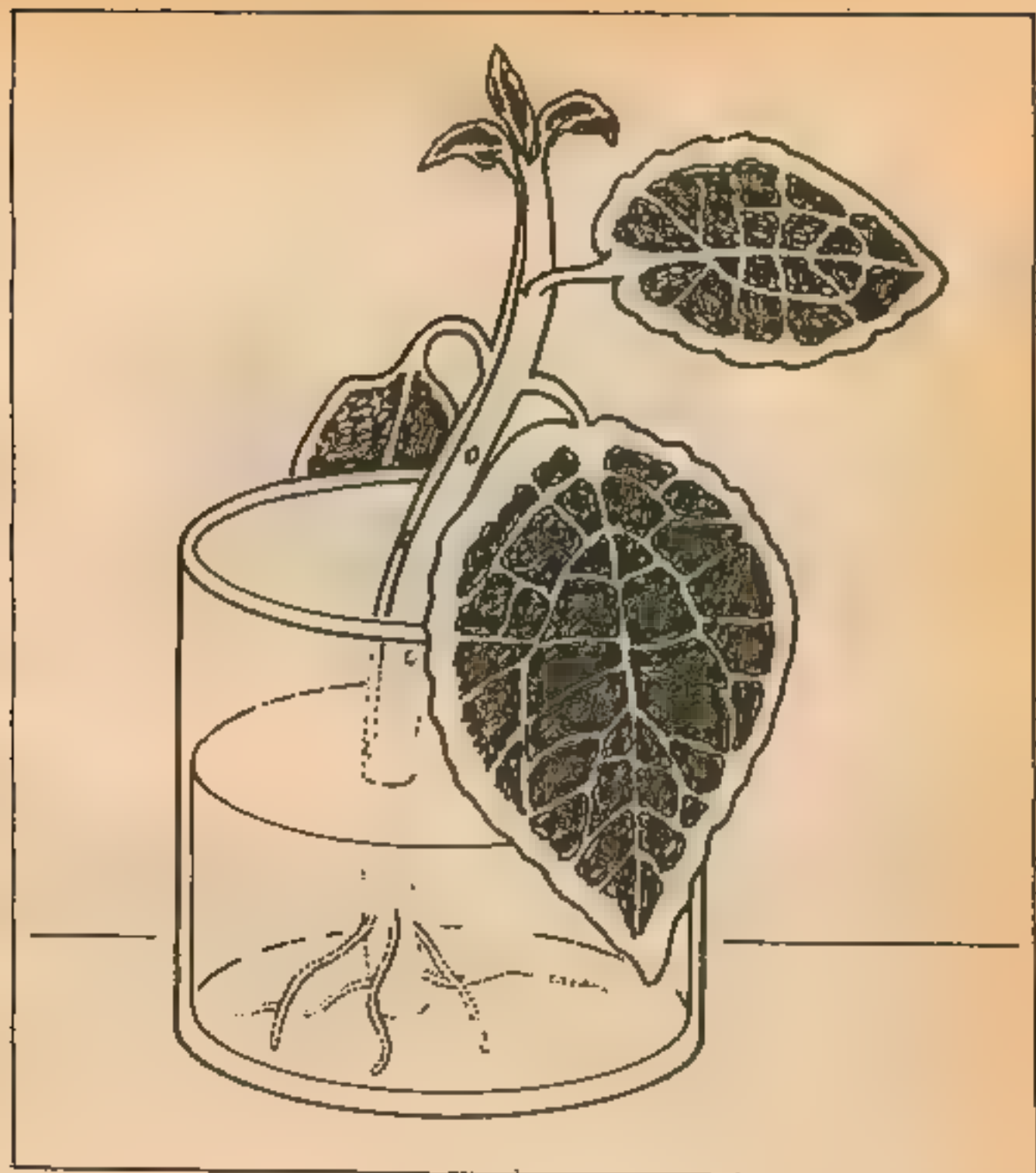
be opened every few days and checked for mold. Stagnant air and damp conditions give mold and fungus a helping hand.

Most tender and herbaceous or non-woody plants may be propagated in this manner and you'll easily add to your plant collection.

Another old-time method is rooting cuttings in a glass of water. It works for ivies, impatiens, coleus (illustrated),



begonias, wandering Jews, geraniums and many more. After the roots begin to grow, add small amounts of sand or soil to the water every day or so, and you will prevent a tangled mass of roots (always the case when pulling them from water) when ready to transplant. You will also have general success as the soil stimulates the growth of root hairs.



Plants by Division

Another easy way to produce new plants is by division of root stock. Early spring is the best time, before new growth for the season begins. This process works with plants that form multiple crowns like many of the ferns; it's obviously a bad idea with a single-stemmed plant. The chosen plant may be divided into as many sections as there are individual stems or crowns.

Try to separate the roots as carefully as you can, keeping as many as possible attached to their original stem. Many ferns can be split in this manner when they have become potbound. Snake plants, cast iron plants, and others of this type, make excellent subjects.



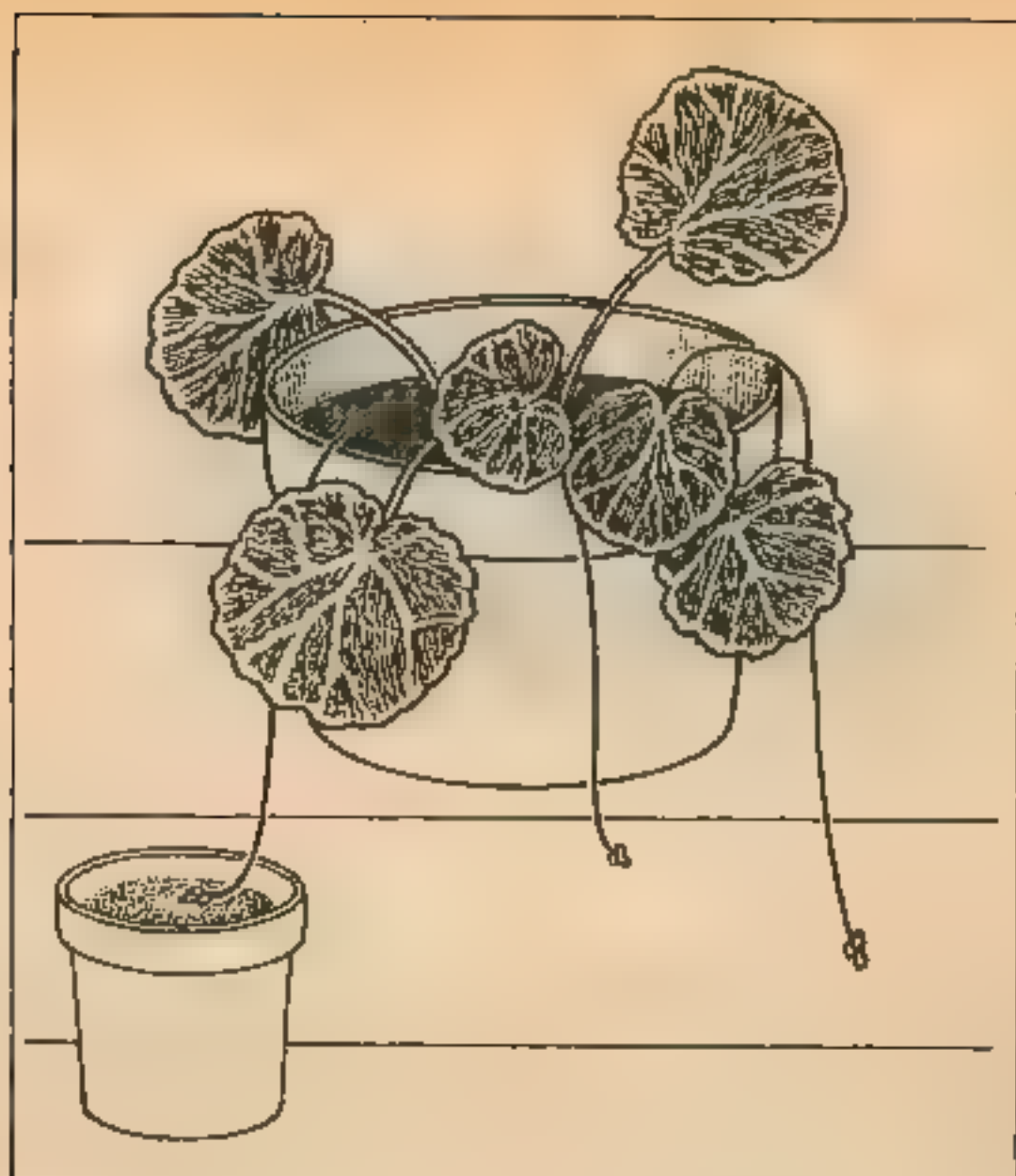
Runners

Any house plants that produce runners with tiny plants at their tips, as strawberry geraniums (illustrated) and spider plants (*Chlorophytum* Spp.) will produce many new plants if the tips are allowed to root. The easiest way is to anchor the small plantlet to a three-inch pot of soil using a bobby pin or paper clip. Make sure that adequate roots have formed, by giving a slight tug, before you cut the runner from the mother plant.

Leaf Cuttings

There is a limit to the number of new plants that can be produced by rooted cuttings; the mother plant has a finite number of suitable stems. But, if you are in no great rush and want to reproduce a large number of a particular plant, then leaf cuttings are the answer. Three general methods are employed.

The first is used with *Begonia rex*. A large, healthy leaf is chosen and the petiole shortened to the length shown. The main veins are then cut at vein junctions, using a sharp knife or razor blade. The leaf is then laid on a moist bed of sand or peat moss, top side up. The petiole is stuck into the medium and the leaf held in place with small stones or bobby pins. The pot is covered with plastic and kept out of intense light. In a few weeks, miniature replicas of the parent plant will sprout on the leaf surface.



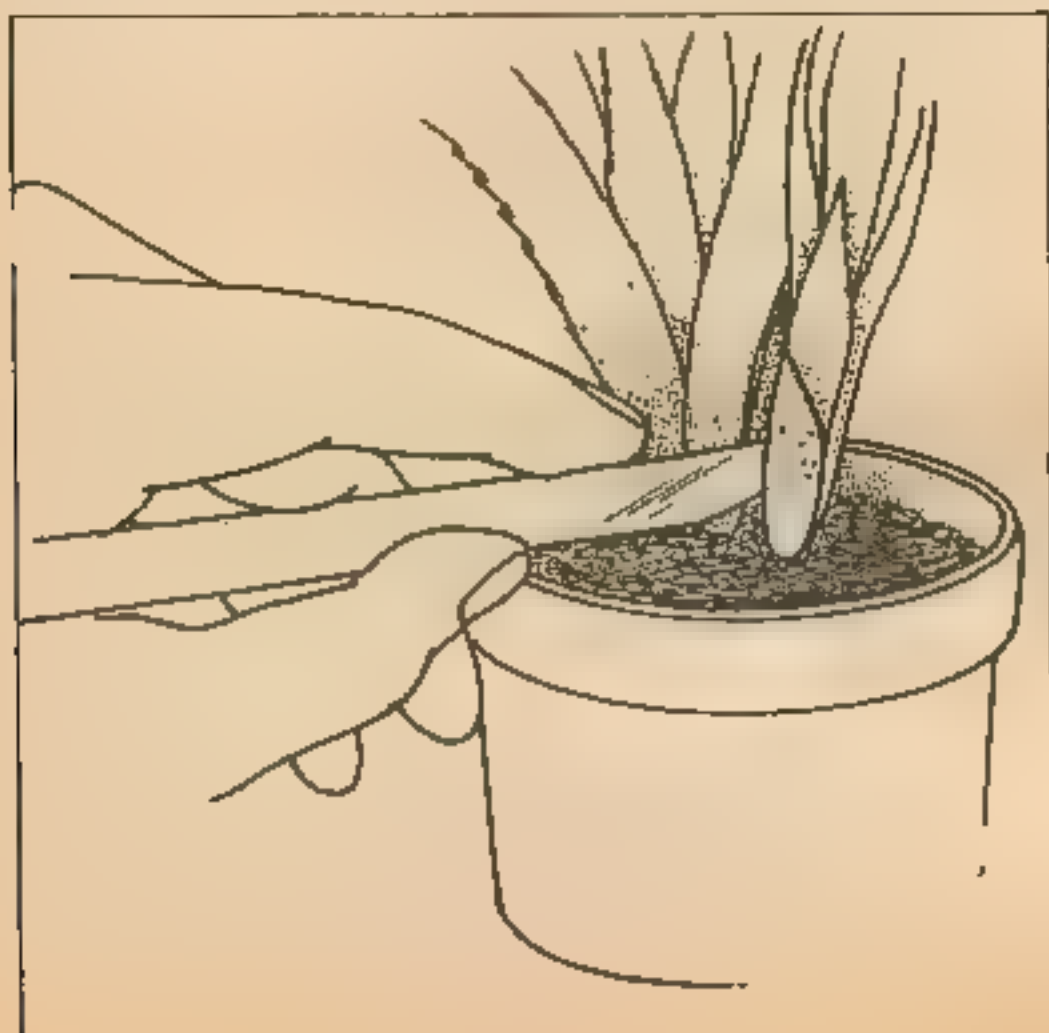
The second method is called leaf-petiole cutting. It's used for Christmas begonias (*Begonia cheimanthus*), geraniums, poinsettias, and most other plants with woody or fleshy branches. It's always a good idea to include a part of the stem with a leaf bud present at the point where the petiole meets the stem. Moist sand, peat moss, or vermiculite makes a good rooting medium. The petiole is planted in the medium; make sure that the base rests in the bottom of the hole and the cutting is firmly set. Check for root growth every few weeks and make sure the medium is kept damp. A cluster of growth buds and new roots will be clearly visible at the base of the petiole.

The third method works for thick and succulent leaves like *Crassula*, the cotyledons, and the many sedums. It often happens quite naturally when a leaf falls from a stem and comes to rest on the surface of the soil. If growing conditions are favorable, tiny roots will quickly form. An army of sedums may be manufactured by removing as many leaves as you want, and sticking their bases in a moist rooting medium of sand or peat.



Offshoots

Most bromeliads will bloom only once—the mother plant will die within a few years after flowering. When I first heard this fact from my Florida friend, I was naturally shocked, as it's very rarely mentioned in garden and houseplant books. Then she told me about offshoots, which usually appear around the base of the mother



plant after it has bloomed, and my faith in nature was restored

The offshoots should not be potted until they are at least eight inches in height and have taken on the characteristics of the mother plant. They should be cut off with a sharp knife as close to the parent as possible and planted in osmunda or other epiphytic media in three-inch pots.

Air-Layering

When a prized dracaena or rubber plant (Ficus) has reached the ceiling, it's time to watch it bend or air-layer it. This is an especially valuable method to produce a mature plant in a short time and relieve the leggy look of rubber plants.



Start the procedure in late spring or early summer by making a diagonal cut, about one and one-half inches long, in the stem at the height you wish the new plant to be. You will have to remove a few leaves above the cut. Keep the cut from healing by inserting a wooden matchstick into the cut. The cut area is then surrounded with thoroughly moistened peat moss or sphagnum and wrapped with plastic, tied top and bottom. Inspect the package every week or so for signs of new, white roots. When the root system is well developed remove the plastic, but leave the moss and cut the parent stem cleanly, just below the roots. Pot in a five- or six-inch pot and be very gentle as the new roots will be quite brittle.

By removing the top, the remaining stem should start to produce new leaves at the leaf axils along the stem.

Cane Sectioning

Dracaena, Dieffenbachia, and Cordyline may be propagated by cutting their stems into three-inch sections, making sure that each section includes a leaf scar, and then placing them horizontally on a bed of moist sphagnum or peat moss. When rooting is well along, the dormant bud will sprout and a new plant is on the way.



CHAPTER SIX

Lichens, Mosses and Ferns

In 1829, Dr. Nathaniel Bagshaw Ward, a London botanist, found a moth chrysalis. Wishing to witness the emergence of the adult moth, he enclosed the chrysalis in a glass jar, with soil at the bottom, and closed the top. After a short period of time, he spotted a tiny fern growing in the sealed bottle. The good doctor was delighted, not only because this "accident" opened up a whole new field of plant research,* but he had found a way to finally grow ferns in the foul air of London.

His invention was called the Wardian Case, and is now termed a terrarium. Poor Dr. Ward must be turning over in his grave these past few years, as banks use his idea as a come-on for new accounts, and Sunday supplement pages promise a "new world of green, that lasts forever in a bottle . . . beauty beyond belief (plants not included)." Department stores now offer ready made terrariums in narrow-necked bottles for quite fantastic prices, and the craze goes on.

Nevertheless, a good idea much maligned is still a good idea and fabricating terrariums can be a fascinating occupation.

MAKING A TERRARIUM

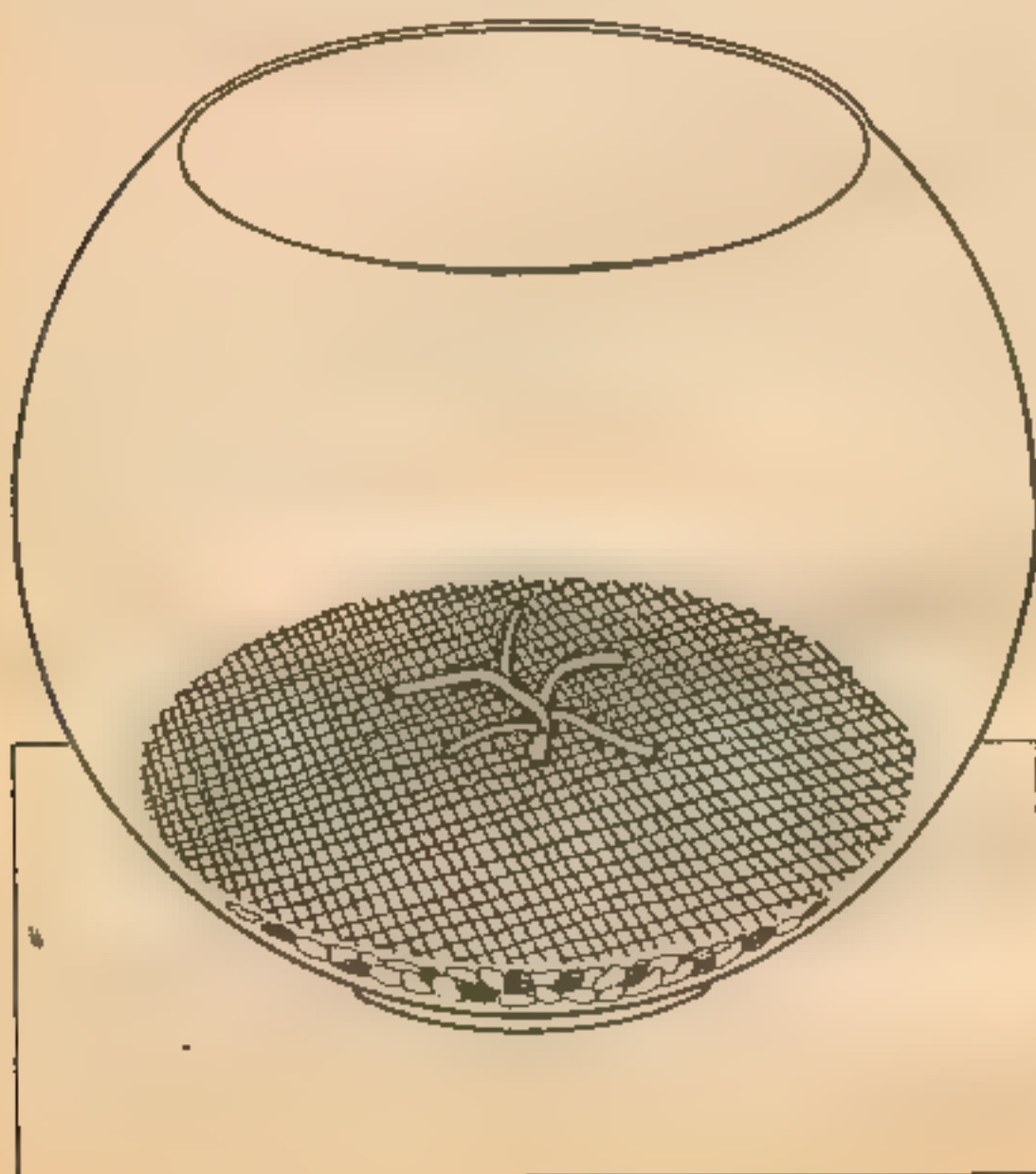
Many people enjoy the "ship-in-a-bottle" approach to making terrariums. You take a large bottle, like a demi-john, with the narrowest neck you can find, and by dint of great manual dexterity, and long-handled tools, plant

* Dr. Ward continued to refine the original bottle garden, and in time his idea was used to transport rare and exotic plants across the seas in complete health and safety.

a conversation piece. There are problems: plants grow, change positions, and litter, not to mention pests and diseases.

I prefer glass bowls with sufficient openings that enable me to remove overgrown plants, trim leaves, and remove leaf-litter. The old-fashioned, flat-sided goldfish bowls still available in variety stores are fine too.

First take your chosen container and clean the glass thoroughly, then dry completely to prevent soil from sticking to its sides. Put a mixture of clean stones, gravel and some charcoal chips over the bottom, so that any excess water is held away from the soil. Now cover the stones with a piece of plastic screening (cheap metal screening will rust and decay, while aluminum screening will form an oxide that might not be beneficial to the plants above) Buy or make a water wick, pushing half through a small hole in the screening and spread the rest above. This will absorb any excess water and slowly distribute to the soil above.



Now add your soil mix made to the following proportions:

- 1/4 humus or leaf mold
- 1/4 sphagnum moss
- 1/4 peat moss
- 1/4 sand and gravel

As we've mentioned before, use sterilized soil; any mold or mildew spores in unsterilized soil would have a field day in the closed atmosphere of a terrarium.

Slowly spread the soil mix over the wick and screening, making sure that the mix is damp, but not wet. A good rule of thumb is to make the soil and drainage material equal to about one-quarter of the depth of your container.

Now you are ready to plant, spreading the roots out and gently but firmly covering them with soil. Take it slowly to prevent dirtying the clean glass. When planting is finished, carefully water the soil. Any excess will drain to the bottom to be redistributed to the soil by the wick. Obtain a piece of glass for a cover and remove it once a day to allow for air circulation, unless your bowl is planted with bog plants which need high humidity. If too much moisture condenses on the container sides, it's bad for most plants and should be remedied by removing the cover and allowing excess water to evaporate.

Unless you've made a desert terrarium (by following the same general plan, but substituting the cactus-soil mix and following a reduced watering schedule) keep the smaller bowls away from the direct rays of midday sun; temperatures in these containers can rise rapidly and quickly bake the contents.

The best terrarium, especially for wild plants, is the aquarium. It fits well upon a shelf, and covers are available with built-in illumination, allowing placement in otherwise dark corners. Due to its rectangular shape, sections of plantings can be easily changed without disturbing the rest.

A typical one-gallon size measures about 9 by 6 by 7 inches, the four-gallon size is 13 1/2 by 9 1/2 by 9. Larger sizes are available, up to fifty gallons or more.

Remove the glass on one of the long sides by peeling away the flexible aquarium cement and replacing the pane with a piece of mirror. The mirror will reflect light, make the plant display appear larger, and act as a sun shade.

By using individual plants potted in small containers, such as plastic margarine cups, custard cups, thimble-sized clay pots, or larger containers if the plant and aquarium are big enough to warrant it, you can mix many types of plants. Wild flowers that require winter dormant periods may be enjoyed till their leaves fade in fall and easily removed for the following year. Acid loving ferns may be grouped with flowering bulbs, small insectivores like the parrot pitcher plant which enjoys water at the roots—can live in harmony with a small Bird's Nest Fern. The combinations are endless and allow for a great deal of experimentation.

The bottom of the aquarium should have a layer of stones and gravel—about an inch will do—to insure adequate drainage. If you use containers without drainage holes, put some crocking in the bottom before adding soil.

When planting, put the small containers to the front, with the larger pots at the rear, filling the gaps between with sand or gravel or sphagnum moss and moss-covered rocks to achieve a naturalistic look.

Many wild plants adapt quite readily to terrarium conditions, and this chapter and Chapter 11 mention many of them. The following is a list of popular house plants that will do well especially when young, at average room temperatures without direct sunlight:

Variegated Chinese evergreen, *Aglaonema commutatum*

Spotted evergreen, *A. costatum*

Queen's tears, *Billbergia nutans*

Dwarf mountain palm, *Chamaedorea elegans*

Miniature grape ivy, *Cissus striata*

Earthstars, *Cryptanthus* spp.

Gold-dust dracaena, *Dracaena godseffiana*

Ribbon plant, *D. sanderiana*

Persian violet, *Exacum affine*

Creeping fig, *Ficus pumila*

Hahn's self-branching ivy, *Hedera helix* 'Hahn's self-branching'

Bloodleaf, *Iresine herbstii*

Coral-bead plant, *Nertera granadensis*

Artillery plant, *Pilea microphylla*

Satin pothos, *Scindapsus pictus argyraeus*

Wandering Jew, *Tradescantia fluminensis*

Silvery wandering Jew, *Zebrina pendula*

LICHENS

Lichens are a lowly (botanically speaking) form of plant life composed of algae and fungi living together in a partnership called *symbiosis*. Each partner contributes to the welfare of the other—the algae gaining a controlled environment relating to water supply and protection from the elements, and the fungi receiving nutrients from the chlorophyll activities of the algae. It's a strange partnership that is not entirely understood by botanists. When the fungus and its algal partner are separated in the laboratory, no one has ever been able to reunite them and even approximate the original form.

Lichens provide food for small insects and large mammals. In the Arctic, reindeer moss (*Cladonia* spp.) is the principal diet of caribou during winter; in our own northeast, deer often survive by feeding on local tree lichens (*Parmelia* spp.) when no other food is available. In extreme emergencies, hungry explorers have survived on lichen soup.

Litmus paper, known to all chemistry students, is filter paper that has been impregnated with lichen dyes that are blue in basic solutions and turn red in the presence of acid solutions.

In the long run of nature, the greatest service performed by lichens is pioneering the lengthy process of soil formation; they grow where little else is found, and through the centuries, contribute to the build-up of organic matter and eventually become hosts to other small plants such as mosses.

Don't look for lichens in the heavily polluted urban areas, as they are intolerant of sulfur dioxide and other components of "dirty air." A few may be found growing in suburbs, but the majority need the clean, cool air and pure water of country hills and mountains.

Keep them to a minimum in mixed terrariums as they are touchy to establish. In nature, they are usually found in the open with plenty of light and air. When subjected to wet conditions for too long a period, the fungus grows at a much faster rate than the algae, and starves to death. They are well equipped to withstand long periods of drought by going into hibernation until water is once again available.

I always collect lichens when growing on small rocks, pieces of wood, or branches, so the plants are raised above the terrarium floor, preventing them from becoming too wet. They require fresh air, so are not suitable subjects for a completely sealed container.

Lichens generally reproduce by asexual means, simply forming new plants from broken pieces of the old. They also produce fruiting bodies which are the bright patches of color found on top of their tiny branches, that produce spores,* but no one has ever successfully produced new lichens by germinating these spores. The whole matter is further complicated by the knowledge that the fungal spore must find a compatible alga to join it before a lichen is produced.

The illustration shows some of the more common varieties found in America. Individual species are sometimes difficult to identify without chemical testing, so lichenology has the potential of a lifetime hobby.

Be sure to examine them with a hand lens to clearly see the complexity of form and variations in color.

1 British soldiers (*Cladonia cristatella*) Found growing on branches, bark and mosses, and on the ground. They are named after the Redcoats of revolutionary war fame.

2 Reindeer moss (*C. rangiferina*) Found in large clumps, generally on rocks in elevated places.

3 Pink earth lichen (*Baeomyces roseus*): Likes conditions wetter than most, and grows directly on poor soil. The pink fruiting bodies are of such intense color on gray and misty days, they can be spotted yards away.

4 Boulder lichen (*Parmelia conspersa*) Grows on rocks,

* Spores are reproductive bodies formed by algae, lichens, fungi, mosses, and ferns. They usually contain but one cell and are only one of many steps that lead to a new plant. Seeds are produced only by conifers and flowering plants and contain an actual embryo plant of many different cells and a complicated structure. Seeds grow directly into adults upon germination.



boulders and stone walls. They look like mountains on the Moon.

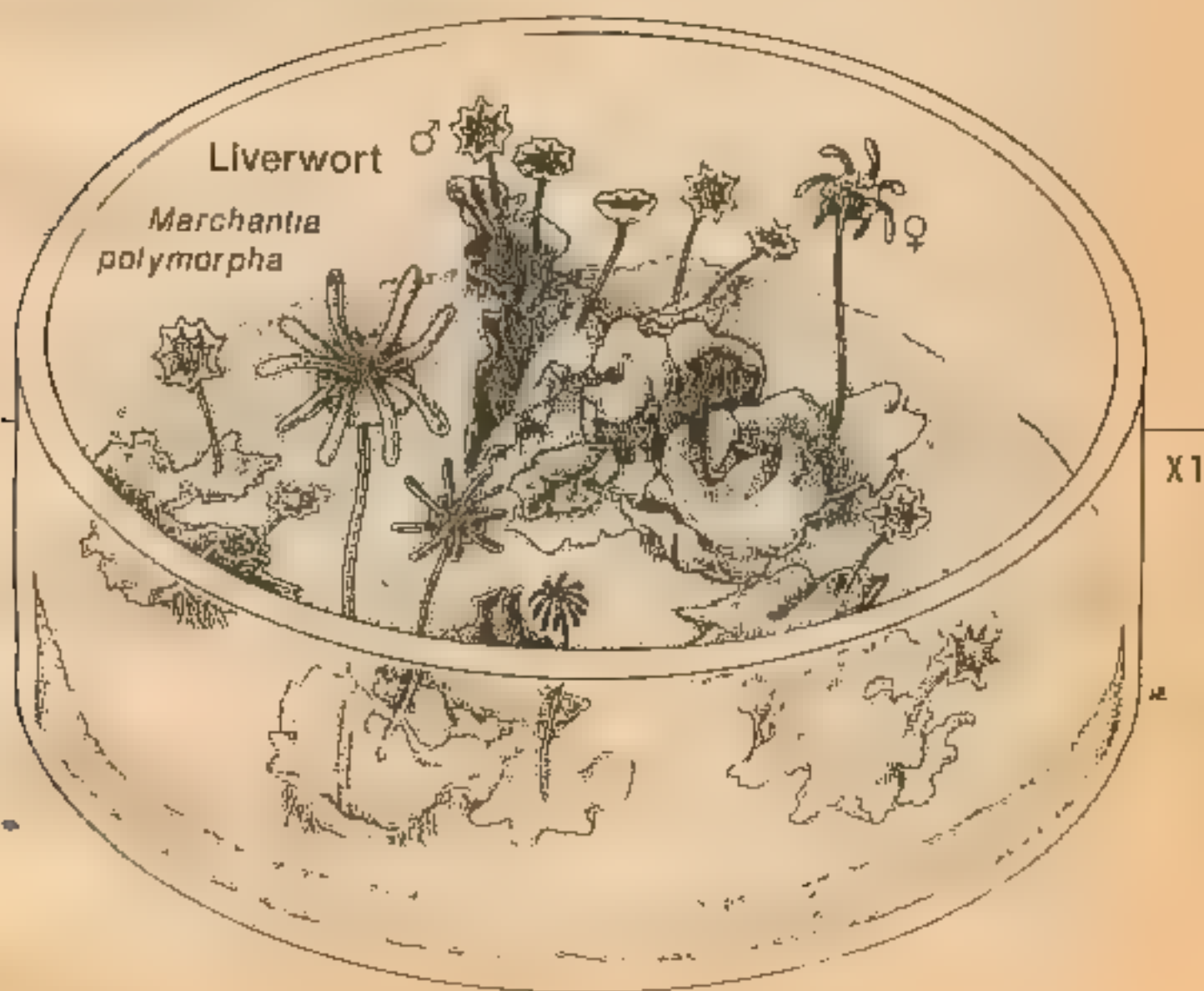
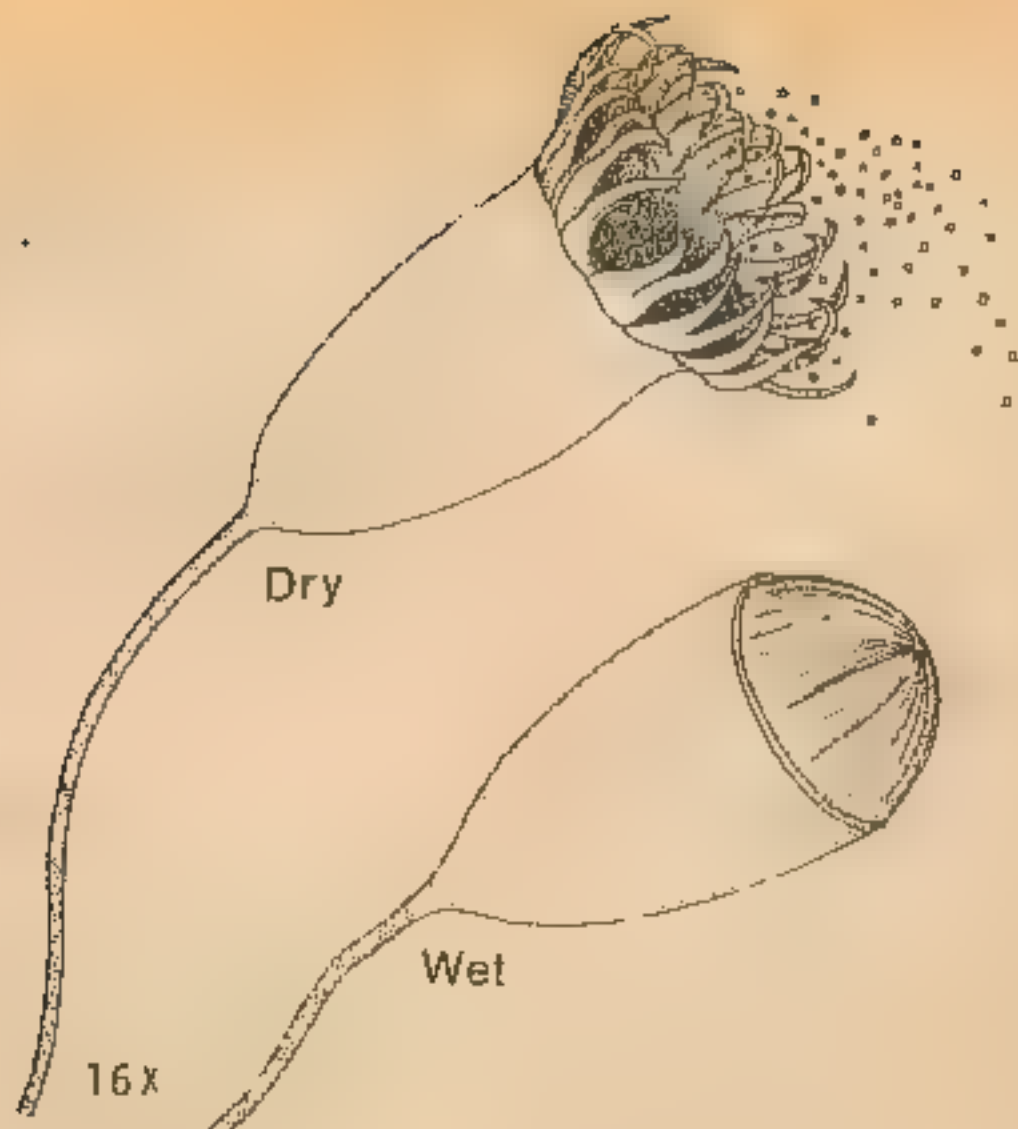
5 Goblet lichens (*Cladonia pyxidata*) Found among mosses on the southeastern side of barren hills. A goblet lichen looks exactly like its popular name.

MOSSES

Mosses are familiar plants of shady habitat. Some are aquatic; many grow in soil or on rocks, the bark of trees, living and dead, stone walls, broken sidewalks, brick buildings and shingled roofs. Although generally classed with liverworts, they differ in having a midrib on the leaf and a tolerance for dryer surroundings.

The leafy growth of mosses are really branches that arise from a spreading green filament produced by a germinating spore. This green filament or protonema grows above and below the soil surface (or anything it can cling to) and when mature, produces the branches and tiny roots or rhizoids. Rhizoids do not grow deeply, just deep enough to hold the plant and absorb water, making mosses very easy to transplant.

When a moss reaches maturity, male and female sex organs are produced on the tops of the leafy shoots. At the time of fertilization these organs swell with water, releasing male sperm cells. With larger mosses, the sperm travel to adjacent eggs when splashed by falling rain. Smaller species depend on dew or melting snow and the sperm swim to the egg. The resulting embryo, or *sporophyte*, develops into a long stalk with a foot that buries itself in the leaves of the moss absorbing minerals and water. The upper end forms a capsule filled with tiny spores. The sporophyte has its own chloroplasts and manufactures food but is still a parasite on the plants below. When the capsule matures, chloroplasts fade, the sporophyte turning a rich brown color. Now the capsule loosens its top and reveals a circle of teeth that control the release of the spores. These teeth are sensitive to humidity and when the air is damp, they remain closed, but when air is dry, they open. The spores are shaken into the wind by a miniature saltcellar.



Most mosses prefer shade. Since they have a poorly developed water distribution system, hot sun dries them out before the water can reach the thirsty cells. The hair-cap moss (*Polytrichum commune*), our largest and most common moss, will grow in open fields, but grass provides some shade and the dew of morning furnishes needed water. Mosses are usually subject to rapid changes of moisture and have developed the ability to "fold up" their leaves when dry, markedly changing their appearance, as they look dehydrated.

When collecting mosses for a home terrarium, take a pH tape along and check the acidity of the local soil. Most mosses are finicky about pH and will quickly die if the balance is not maintained.

The illustration shows seven common mosses of the United States.

1 Sphagnum moss (*Sphagnum acutifolium*) is the common species found in wet and boggy places. As sphagnum matures, the older parts of the plant begin to decay, while the younger moss continues to grow on the top. The decayed sphagnum is called peat moss and over a period of years it will slowly encircle and fill small ponds, turning them into quagmire.

2 Feather moss (*Hypnum cristacastrensis*) forms dense masses of yellow-green, plume-like branches and is one of our most beautiful mosses. Look for it on rich woodsy soil, under the shade of trees.

3 Woodsy mniium (*Mnium cuspidatum*) is common in parks, lawns, and moist woods where it grows on soil or decayed wood. When dry, it quickly shrinks and the tiny leaves look like wrinkled tissue paper. When water is again abundant, the leaves become a bright glossy green. One of the first sights of spring are the green sporophytes.

4 Fern moss (*Thuidium delicatulum*) grows in dense mats on earth, stones, and dead tree branches, and looks much like fine embroidery done with a lustrous, dark-green thread.

5 Cord moss (*Funaria hygrometrica*) has capsule stalks that are straight when wet and twisted like rope when dry. Reacting to minute changes in humidity, this coiling



action lends itself to an overall spore distribution. Look for it on old, abandoned foundations and burned-over soil.

6 Hair-cap moss (*Polytrichum commune*) grows stems up to a foot long. The sporophytes appear in early spring or late autumn, maturing in July. Considered a weed by most farmers, it was once used by early Americans to stuff pillows.

7 Pincushion moss (*Leucobryum glaucum*) forms large gray-white tufts found in moist woods, looking exactly like its common name. If introduced to a terrarium, they often give a bonus of seedlings from nearby flowering plants.

Meadow Spike moss

In addition to mosses, a tiny, pale-green creeping plant belonging to the Selaginellas or spike mosses, grows in Northeastern America. Found in meadows, along ponds and streams and sometimes lawns, it's an excellent little plant for a woodsy terrarium. The leaves are evergreen when given the protection of a terrarium.



FERNS

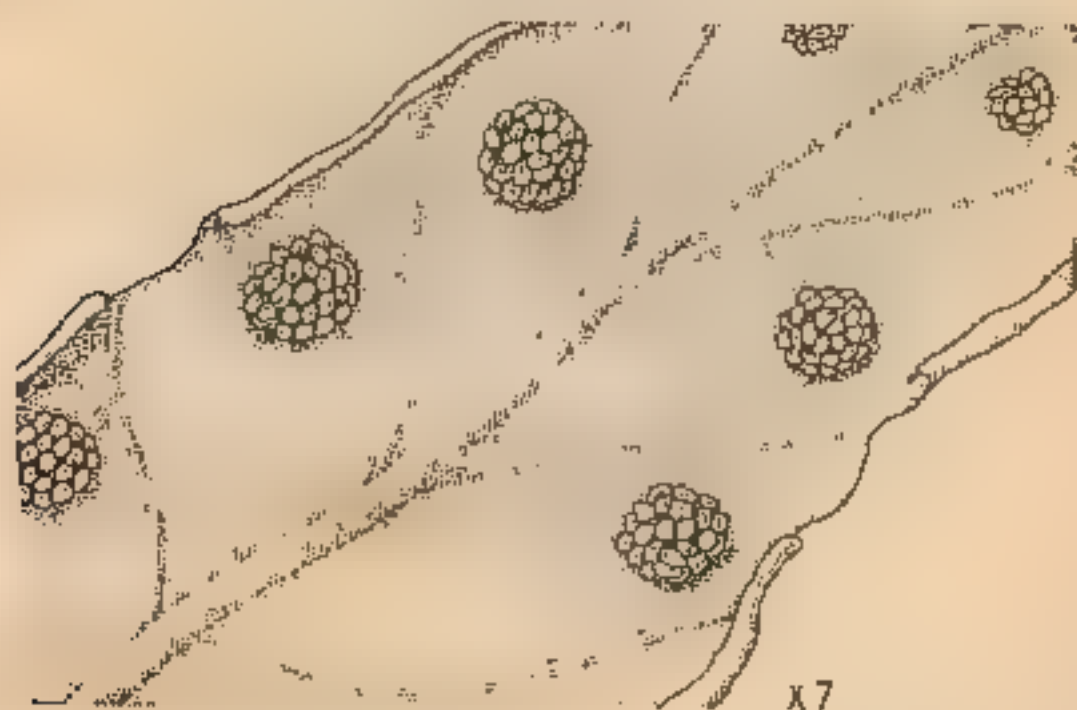
Two hundred fifty million years ago, vast jungles of tree-sized club mosses, horsetails and ferns covered much of the earth. The giant aspects of these plants have vanished with time, but when walking through a shady woods in midsummer surrounded by the lacy growth of ferns, the jungle effect can be readily appreciated.

Ferns do not bear flowers but reproduce with spores produced on the leaves. Their stem, called a rhizome, either creeps along the ground year by year or stays in one place forming a central crown which slowly increases in size. The rhizomes are perennial. The leaves in many of the northern species die down every fall and are deciduous in character. Others are evergreen as most of the tropical species. Roots are adventitious and grow from the lower side of the rhizomes.

Ferns are relatively easy to transplant, but make sure the soil conditions of the wild match those of cultivation. They are easily divided by cutting the rhizomes. As with most plants, spring is the best time to do this. Dividing ferns with crowns is a bit more tricky; cut the crown with a sharp knife, trying not to disturb the foliage and roots.

Life Cycle of a Fern

Ferns begin their life cycle by producing spores that are discharged from clusters of spore cases called *sori*. Sori are found on the undersides of fern leaves and are often mistaken for insect infestation or disease. A few ferns like osmunda (*Osmunda* spp) and sensitive fern (*Onoclea sensibilis*) send up special stalks bearing spore cases which are easily recognized because they lack leaves, but they are in a distinct minority.



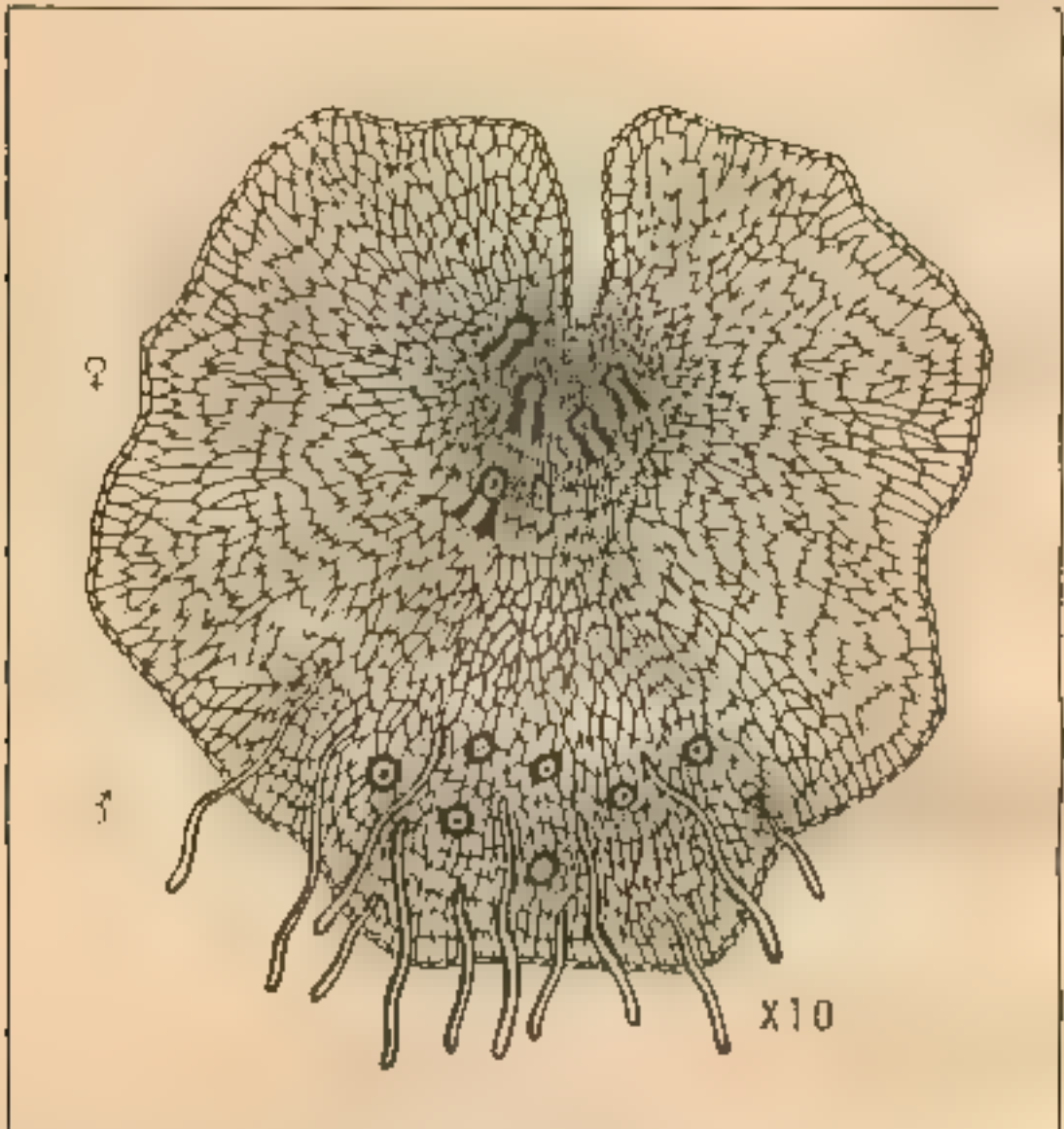
The spore cases, at first green, turn brown as they mature. When dry, the walls of the sori bend back and discharge the dustlike spores to the air. Just as with

mosses, when humidity is high, the sori walls stay closed.

With proper conditions of temperature and moisture, the spores germinate and grow into a flat, heart-shaped structure about one-quarter-of-an-inch wide, called a *prothallium*. Separate male and female organs grow on the underside and produce eggs and sperms. With water from dew, rain, or snow as a medium, the sperm swim to the egg and fertilize it. In a short time an embryo fern begins to develop.

Propagating Ferns

Although the fern life cycle sounds a bit complex, they are very easy to grow from spores. Unlike flowering plants all fern species have the same general requirements for germination.



Absolutely sterile conditions are mandatory. The growing conditions for fern spores match those of mold, fungi, and other undesirables. Use three-inch clay pots, scrubbed and clean or a Riviera self-watering pot. I favor the Riviera because it keeps the medium moist without

constant watching and still allows air circulation from the pot bottom

Crock the clay pots, and fill to one-inch of the rim with a sterilized soil mix of one-third potting soil, one-third peat moss, and one-third sand. Tamp the mix, making it smooth and level. Soak the clay pots and drain excess water.

Cast the spores at any time of the year, one species to a pot, using the folded paper method from the seed germination chapter. Cover the pots with glass and put them in a warm spot (65°F.–70°F.), away from direct sunlight. Check the medium to keep it from drying out. If it starts to dry, soak the pots, don't water from the top. The germinating spores should not be disturbed.

Some species will germinate within a few days, others will take a few weeks, so be patient. As the prothallia grows, a green cast will appear on the surface of the soil. In about three months time, the prothallia will reach its full three-quarter inch size. If you have achieved excellent spore germination, thin the prothallia out so they are about an inch apart. One of the interesting things I remember from college botany is that only the male organs will usually develop if the prothalli are too close together, so I always thin them out at this stage. Falling condensation from the glass cover should provide enough water for the sperm to swim to the egg, but you might have to mist the surface. The tiny plants will now begin to develop. As the leaves grow larger you will have to thin the plants again. When three or more fronds have appeared, transplant to individual pots. You will now have a more-than-adequate supply of native (or tropical) ferns for your terrarium where they should thrive until large enough to go outdoors.

When growing ferns in pots or in terrariums it is not at all unlikely for germination to take place entirely without your help or knowledge, and baby ferns will pop up in the most unlikely places. I have a mango tree in a self-watering pot, and last year noticed that the soil was covered with green—I immediately thought of an algae attack until I examined the growth under a microscope and found prothalli from spores of a fan table fern (*Pteris cretica* 'Wilsonii') located about five pots away.

Collecting Native Ferns

When collecting native ferns (or any other plant) remem-

ber that you are gathering plants and not out to lay waste to field and woods. Don't dig any plants on state and public lands, as they are usually protected by law. If collecting in a woods that is not your own, ask permission from the owners. You'll be surprised by the generosity of most landowners, if you're polite enough to ask. Land slated for imminent destruction by developers is a good place to look for plants, because they'll be destroyed if not removed, but make an attempt at getting permission anyway, so your conscience is clear. And don't overlook roadside ditches out in the country, as many ferns enjoy the moist conditions found there.

Tender or Hardy Ferns

Ferns are tender or hardy, and evergreen or deciduous depending on their environment and type. The tropical and southern ferns are tender and will not survive northern winters outside. Our northern ferns are perennials and hardy. Some drop their leaves every autumn and many are evergreen. I've grown hardy deciduous ferns indoors that have been brought into the house when mature. They must have a dormant period during the winter, and unless you have a greenhouse, they prefer terrarium conditions while in active growth. The evergreens, although green during the winter demand the same rest period. If you have ample storage space, about 40°-45°F., these ferns make wonderful pot plants for summer decoration, then stored till the following year.

So when collecting live plants, wait till the end of the growing season, before the first frost in your area. Choose young and small plants. Deciduous ferns, if very young, will stay green all winter under terrarium conditions. Dig



Young Fern Leaf

deeply enough to protect the rhizomes and take enough soil to keep the plants from wilting on the way home. Put your specimens in plastic bags, but don't seal the tops. Always make a note of the locality where you found them for future trips and test the pH of the soil. A lot of ferns are not fussy about pH, but a few resent any change.

Collecting Spores

Most ferns have mature sori in the early fall, and in my opinion the best way of getting plants is to grow your own. When asked, most gardeners and growers do not mind giving a tiny section of leaf to an interested person. Ferns usually suffer some damage to their leaves during the summer by animals and weather, so it's no problem finding broken leaves to take home without disturbing established plants.

The illustration shows three hardy evergreen native American ferns suitable for terrariums:

1 Ebony spleenwort (*Asplenium platyneuron*) is an evergreen found from Maine to Florida. It grows from nine to eighteen inches high, with dark-green shining leaves. While said to prefer alkaline soil, I have two growing beautifully under a large white pine and surrounded by pine needles, so keep your eyes open wherever you are!

2 Common polypody (*Polypodium vulgare*) generally grows about six inches high and is evergreen. *Vulgare* is the Latin word for common when used with plants, for this fern is not vulgar in any sense. In nature it prefers to grow on rocks with a minimum of soil throughout North America.

3 Christmas fern (*Polystichum acrostichoides*) is green at Christmas. It varies between a foot or two in height depending on growing conditions, preferring a slightly alkaline soil. Found on rocky, shaded slopes, or around old stone walls from southern Canada to Florida.

TROPICAL FERNS

Unless working with terrariums, the best ferns for the house come from tropical regions of the world. Like their northern cousins, they prefer partial shade during the summer months but winter sunlight is beneficial. Soil



should be evenly moist, not wet. The delicate roots need constant water but will not survive in soggy soil. I use the standard potting mix but add another part of sand.

When transplanting, increase the size of pots by one inch, no more. If the fern is a specimen* and the pot is too large already, trim back the roots, repot and thin the foliage to compensate for root loss.

Ferns prefer high humidity so if your rooms are dry, mist the leaves daily, and in summer twice a day.

Average home temperatures will suit most ferns.

If ferns are attacked by scale, and you don't become aware of it until the petioles are covered with these blasted insects, it's best to destroy the plant. Unless the plant is small, it's almost an impossibility to track them all down, and most commercial sprays are harmful to ferns.

The illustration shows four tropical ferns:

1 Crisped blue fern (*Polypodium aureum* 'Mandarinum') grows twelve to eighteen inches high and the leaves are a beautiful milky-blue. To propagate, cut the rhizome.

2 Button fern (*Pellaea rotundifolia*) has fronds to a foot in length. The leaves are dark green and leathery in appearance. Propagate from spores.

3 Fan maidenhair (*Adiantum tenerum* 'Wrightii') has fan-shaped leaflets of a fresh green color. This fern requires abundant water, so I pot in a self-watering pot. Keep the humidity high, mist often. It likes a rest period in the winter. Divide older plants.

4 Bird's-nest fern (*Asplenium nidus*) sends stiff fronds of shining green from one to three feet in the air, depending on conditions of growth. The new fronds arising from the central crown look like a bird's nest. It too needs abundant moisture and misting and is potted in a self-watering pot. Propagate from spores.

HORSETAILS

Horsetails are represented by one genus, *Equisetum*, and are found throughout North America. The stems have a very high silica content and in pioneer days were used to clean and polish cooking utensils. If you're ever caught

* A specimen plant is usually a perfectly grown and superb example of its species—excellent in every aspect.





on a camping trip without a scouring pad, they really work.

E. hyemale grows along streams, lakes, swamps, in roadside ditches, and often on the edge of railroad beds. The evergreen shoots grow from a perennial rhizome. Since they are not fussy as to drainage, I keep a large clump in a nine-inch pot without a drainage hole. All summer, the pot sits in the full sun and is brought inside in early fall to the sunporch. When outside, rainwater is all it needs, but indoors I water every two weeks or so. Standard potting mix works well, and the clumps are easily divided in spring, when they begin to break the pot.

The spores are in the cone-like caps, and follow the reproductive pattern of ferns. The rings on the shoots have whorls of tiny, scale-like leaves, and photosynthesis occurs primarily in the stem.

The plant grows about three feet tall and has a striking, architectural beauty all its own.



XI/2

4



Common Horsetail
Equisetum hyemale

CHAPTER SEVEN

Vines About the Window

Whether fast-flowering or slow-growing, vines are a wonderful addition to the plant types available to the indoor (and terrace) gardener. With free-ranging imagination and a minimum of expense, walls or windows are easily framed with luxuriant growth. The vines pictured in this chapter have few cultural demands, the only real problem being the amount of time you wish to devote making devices that will hold them up!

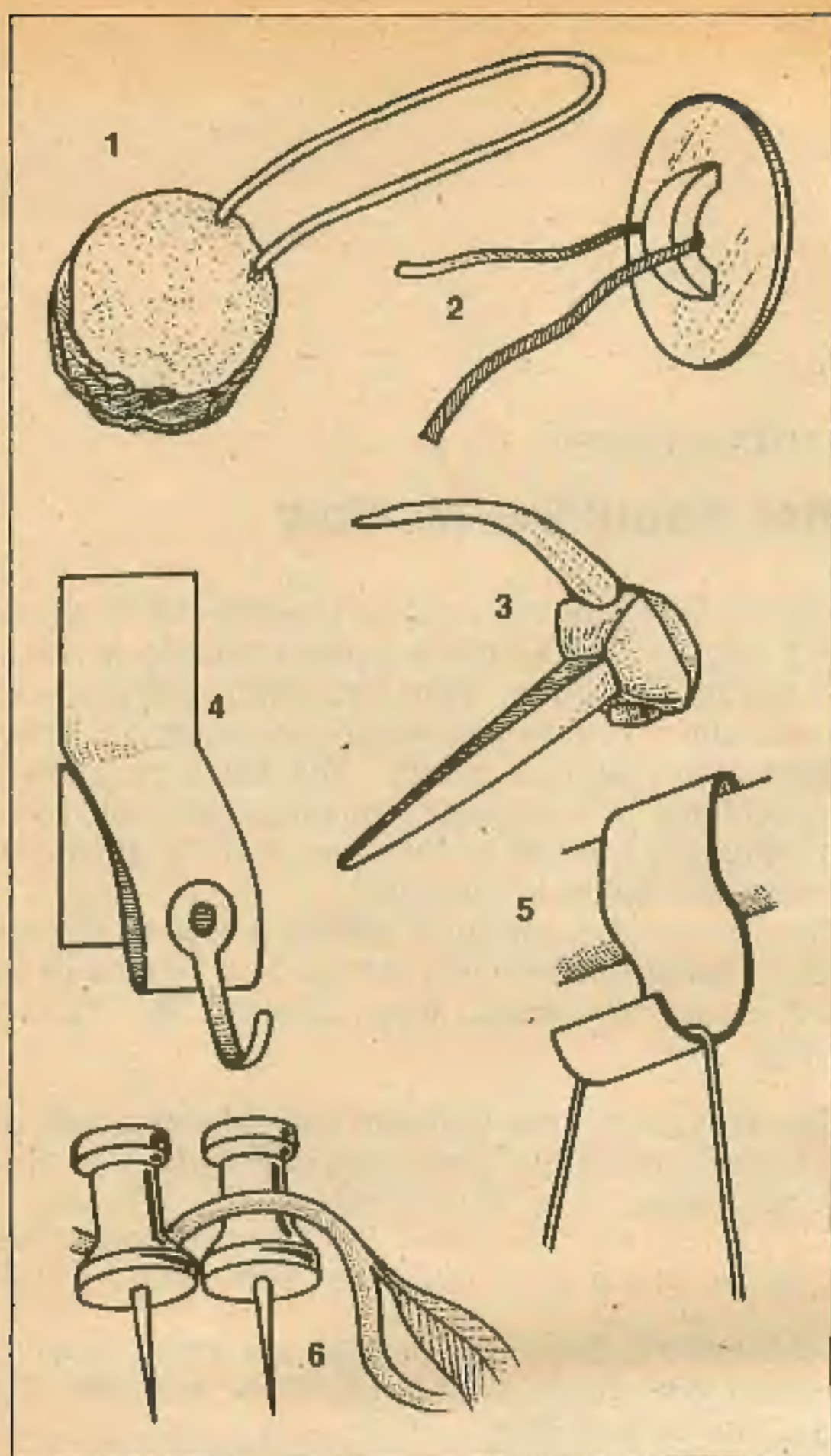
The following illustration shows a few of the gadgets on the market for fastening strings and fishline to walls of wood, stone, or brick. (See Chapter 16: "Sources of Supply")

1 The Wayward Vine Support consists of small cement disks, about three-quarters of an inch wide, that are glued to brick, stone, tile, or concrete walls. The wire bends easily to hold the vine stem. Supports come in three colors: white, stone gray, and brick red.

2 Feathertown Garden Wall Ties are small plastic disks threaded with green plastic ties. They, too, are affixed to wall surfaces with glue.

3 The Francis Wall Nail is an English import that is worth buying for the box alone. The nails are steel and should be sharply tapped into the masonry between bricks and concrete blocks. The soft lead strap bends easily to hold where you want it.

4 Canvas picture hooks are glued to plaster walls, making an excellent anchorage for fish line or string.



5 Molding hooks are made for hanging mirrors and pictures but do double duty for vines.

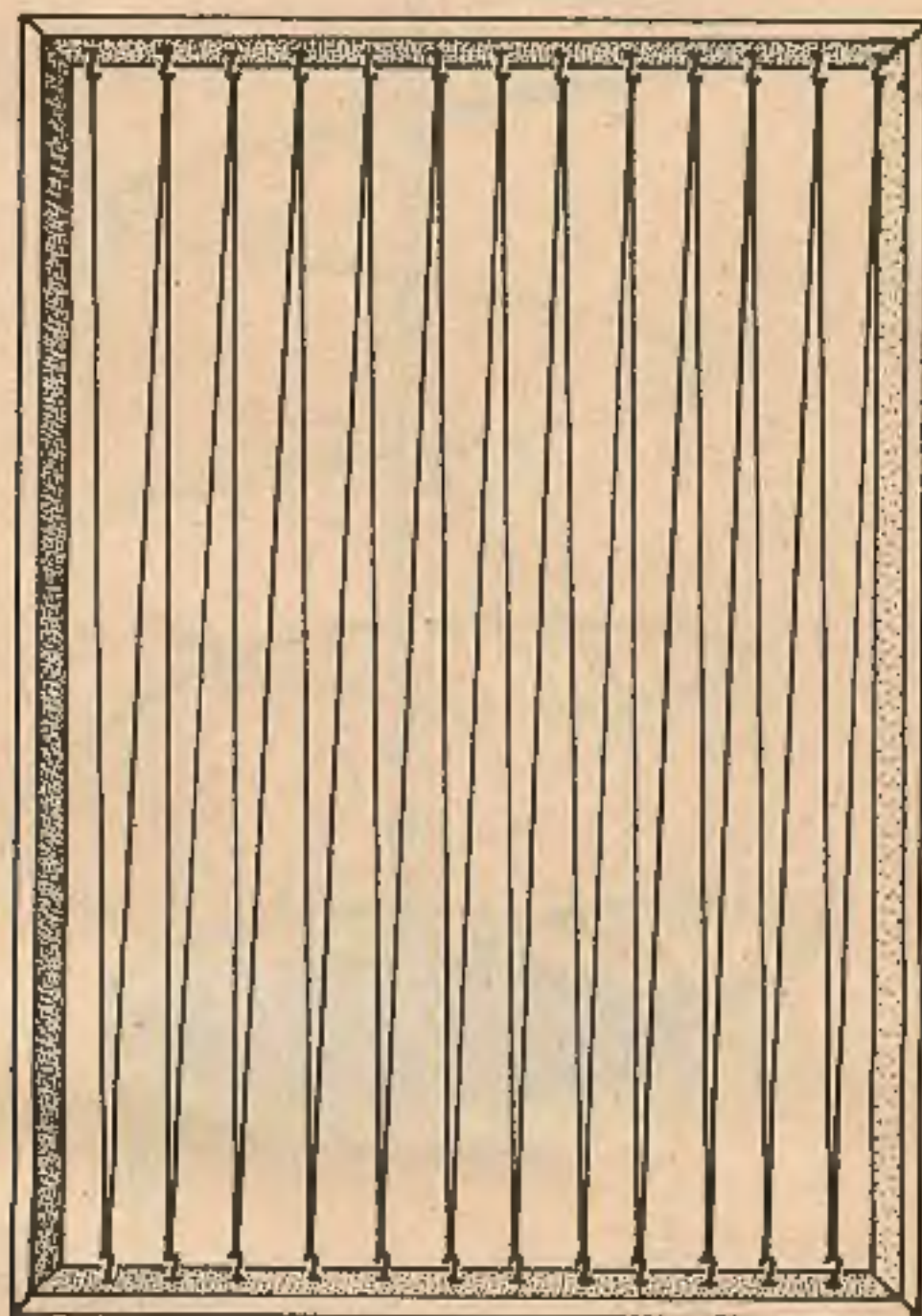
6 Map pins, when used in pairs, hold vine stems, especially around doors and fancy woodwork.

In addition, all the basic stock of hardware stores—nails, staples, cuphooks, tile hooks for bathroom walls

{not to mention towel bars installed vertically}—can serve the purpose of supporting vines.

In most garden stores, you can buy ready-made, folding trellises of wood which expand to twelve feet in length. Held by a one-by-three inch frame they make a perfect room divider. Or simply make your own with wooden lathing and small aluminum nails.

Even snow-fencing, when stained and attached to a wooden frame, becomes an attractive trellis for vines. Plastic fish line or rope can be strung on a one-by-three inch frame from cup hooks to screen a public window effectively. If you have an electric drill, use evenly spaced holes to replace the hooks.



Another very effective support for a large vine such as a passion flower can be made from aluminum clothesline, and a center pole of either doweling or a one-by-one inch piece of wood, cup hooks, and wire. The wire frame can

